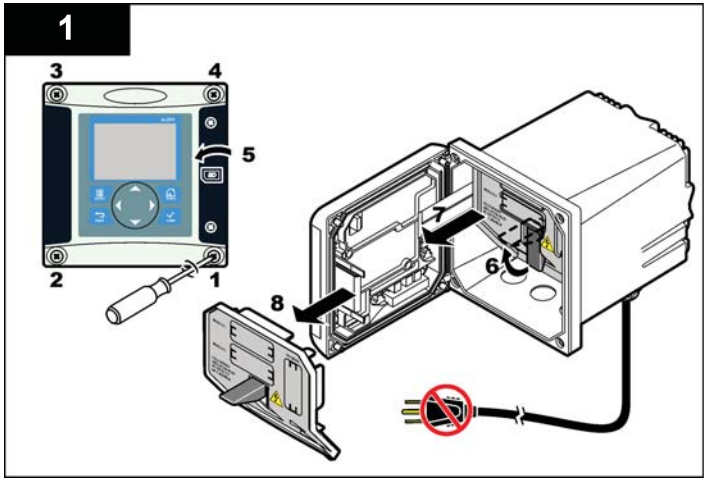
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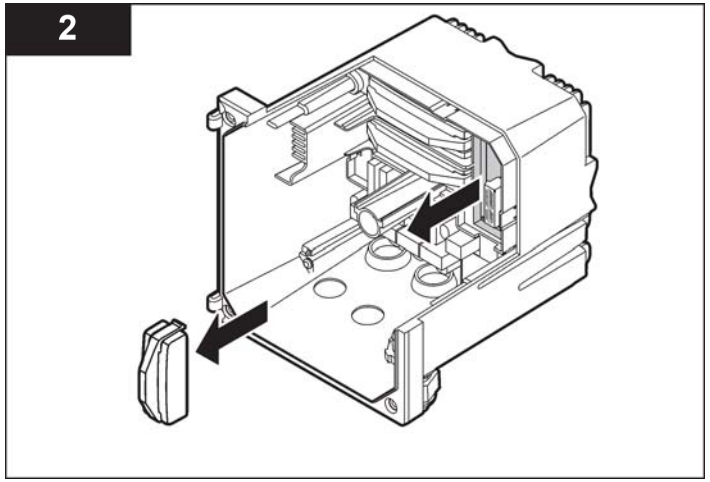
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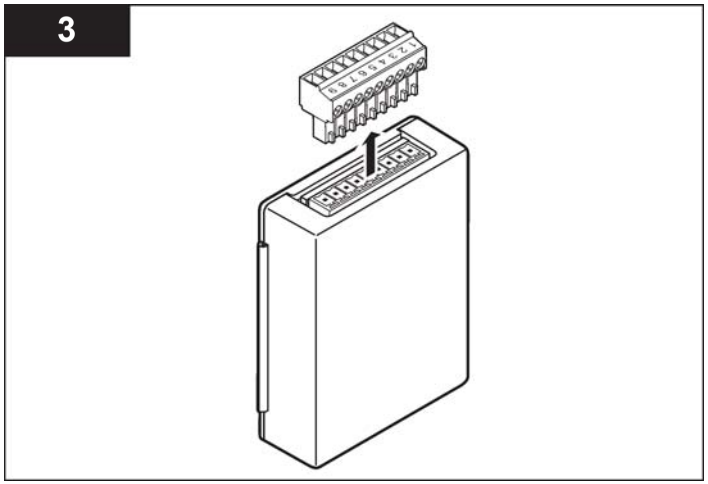
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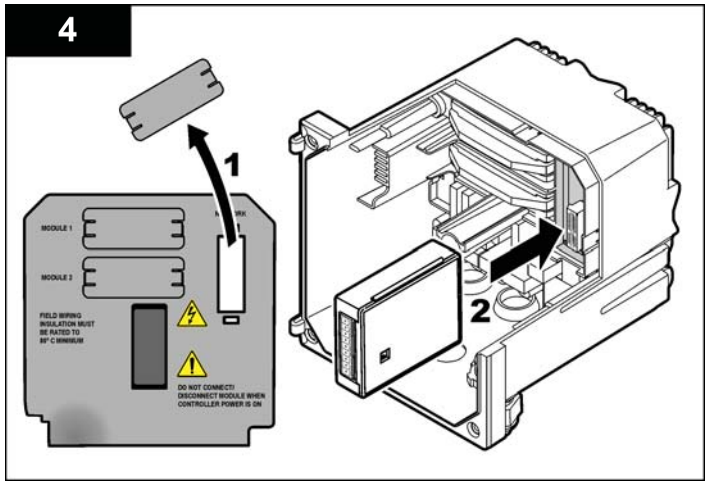
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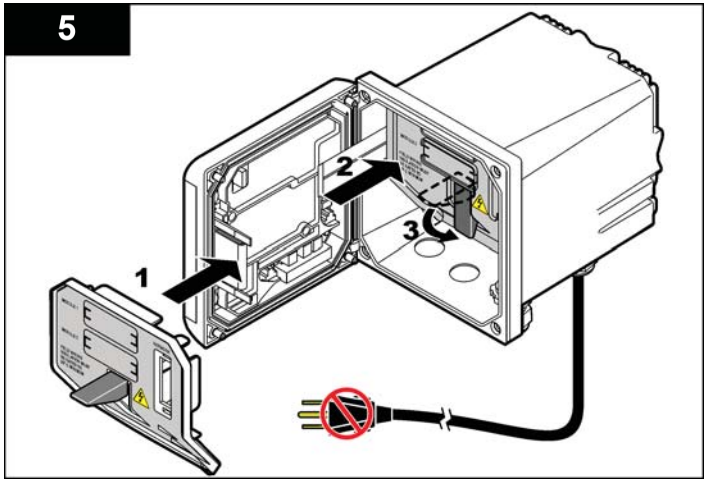
MODULE 1
MODULE 2
FIELD WIRING INSULATION MUST BE RATED TO 90° C MINIMUM
DO NOT CONNECT/ DISCONNECT MODULE WHEN CONTROLLER POWER IS ON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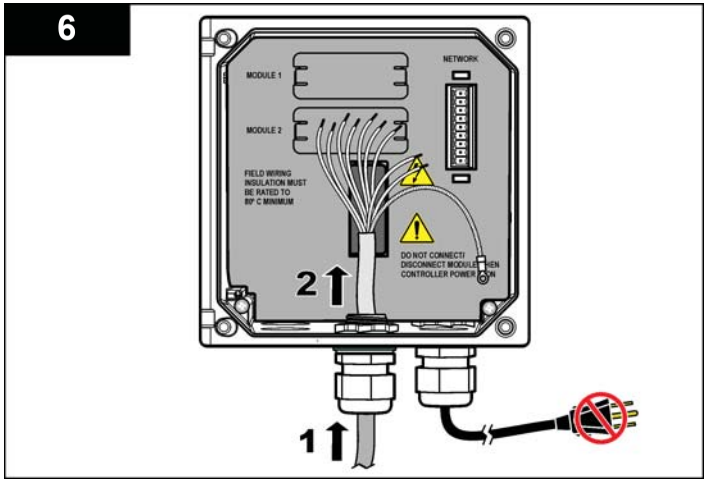
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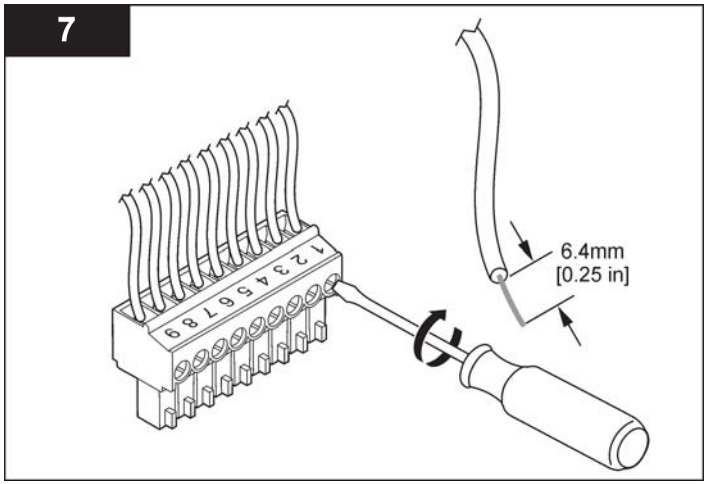
MODULE 1
MODULE 2
NETWORK
FIELD WIRING
INSULATION MUST
BE RATED TO
80° C MINIMUM
DO NOT CONNECT/
DISCONNECT MODULE WHEN
CONTROLLER POWER IS ON
2
1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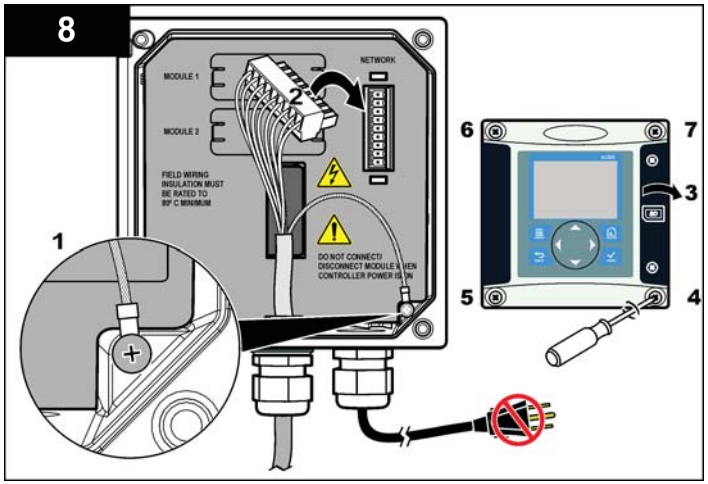
1 2 3 4 5 6 7 8 9
6.4mm
[0.25 in]


8
MODULE 1
MODULE 2
NETWORK
FIELD WIRING
INSULATION MUST
BE RATED TO
80° C MINIMUM
DO NOT CONNECT/
DISCONNECT MODULE WHEN
CONTROLLER POWER IS ON
1
2
3
4
5
6
7

Operation

Configure a 4-20 mA output module

The Network Setup option appears in the Settings Menu only if an analog output module or other network module such as Modbus or Profibus is installed in the controller.

Outputs for analog output modules are set at 4-20 mA. Outputs can be assigned to represent a measured parameter such as pH, temperature, flow or calculated values.

1. From the Settings menu, select Network Setup.
2. Select Edit Name and enter a name for the module. Push **ENTER** to save the name.
3. Select an output (A, B, C) and push **ENTER**.
   a. Highlight an option and push **ENTER**.
   b. Make a selection from the list or update the entries.
   c. Push **ENTER** to save the changes.

Option	Description
Select Source	Selects the output to configure—None, sensor 1 name, sensor 2 name, calculation (if set up). For sensor output, Select Parameter sets the measurement options. When the measurement is autorange, Set Range sets the range.
Set Low Value	Sets the 4 mA value (default: 0.000). (Range and units depend on sensor)
Set High Value	Sets the 20 mA value (default: 1.000). (Range and units depend on sensor)
Set Transfer	Sets the transfer value. Range 3.0 to 23.0 mA (default 4.000).
Set Filter	Sets a time-average filter value of 0 (default) to 120 seconds.

Diagnostics and tests menu

1. From the Settings menu, select Diagnostics and Tests.
2. Select an option and push **ENTER** to perform the function or view the data.

Option	Description
Output Cal	Calibrates the low (4 mA) and high (20 mA) values for each of the three 4-20 mA outputs (A, B, C).
Hold output	Sets the hold output options to Hold, Transfer or Release for each of the three 4-20 mA outputs (A, B, C).
Test output	Drives selected output to a known value.
Status	Displays the output value.
Error hold mode	Selects what to do on error condition.
Module information	Displays information about the installed module. • Software version • Bootloader version • Serial Number
Default Setup	Sets the configuration to factory defaults.

Modbus registers

A list of Modbus registers is available for network communication. Refer to www.hach.com or www.hach-lange.com for more information.

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HACH

MODEL DPD1R1, pH SENSOR
MODEL DRD1R5, ORP SENSOR

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Catalog Number 6120218

pHD sc Digital Differential pH/ORP Sensors

USER MANUAL

April 2009, Edition 5

eac/te/dp

Table of Contents

Section 1 Specifications

Specifications are subject to change without notice.

Table 1 Differential pH and ORP Sensor Specifications

Specification Category	pH Sensors[1]	Stainless Steel pH Sensor	ORP Sensors[2]
Wetted Materials	PEEK®[3] or Ryton®[4] (PVDF) body, salt bridge of matching material with Kynar®[5] junction, glass process electrode, titanium ground electrode, and Viton®[6] O-ring seals (pH sensor with optional HF-resistant glass process electrode has 316 stainless steel ground electrode, and perfluoroelastomer wetted O-rings; for other wetted O-ring materials consult the manufacturer)	Immersion mounting only, 316 SS Stainless Steel body with Ryton® (PVDF) ends and salt bridge.	PEEK® or Ryton® (PVDF) body, salt bridge of matching material with Kynar® junction, glass and platinum (or glass and gold) process electrode, titanium ground electrode, and Viton® O-ring seals
Operating Temperature Range	–5 to 70 °C (23 to 158 °F) for sensor with integral digital electronics –5 to 105 °C (23 to 221 °F) for analog sensor with digital gateway	0 to 50 °C (32 to 122 °F) for sensor with integral digital electronics	–5 to 70 °C (23 to 158 °F) for sensor with integral digital electronics –5 to 105 °C (23 to 221 °F) for analog sensor with digital gateway
Pressure/Temperature Limits (without mounting hardware)	6.9 bar at 105 °C (100 psi at 221 °F) for analog with gateway 6.9 bar at 70 °C (100 psi at 158 °F)	N/A (immersion only)	6.9 bar at 70 °C (100 psi at 158 °F) 6.9 bar at 105 °C (100 psi at 221 °F) for analog with gateway
Maximum Flow Rate	3 m (10 ft) per second	3 m (10 ft) per second	3 m (10 ft) per second
Built-in Temperature Element	NTC 300 ohm thermistor for automatic temperature compensation and analyzer temperature readout	NTC 300 ohm thermistor for automatic temperature compensation and analyzer temperature readout	NTC 300 ohm thermistor for analyzer temperature readout only — not for automatic temperature compensation
Stability	0.03 pH per 24 hours, non-cumulative	0.03 pH per 24 hours, non-cumulative	2 mV per 24 hours, non-cumulative
Maximum Transmission Distance	1000 m (3280 ft) with termination box	1000 m (3280 ft) with termination box	1000 m (3280 ft) with termination box
Sensor Cable (integral)	Digital: PUR (polyurethane) 4-conductor with one shield, rated to 105 °C (221 °F), 10 m (33 ft) standard length Analog: Five-conductor (plus two isolated shields) cable with XLPE (cross-linked polyethylene) jacket; rated to 150 °C (302 °F); 6 m (20 ft) standard length	Digital: PUR (polyurethane) 4-conductor with one shield, rated to 105 °C (221 °F), 10 m (33 ft) standard length	Digital: PUR (polyurethane) 4-conductor with one shield, rated to 105 °C (221 °F), 10 m (33 ft) standard length Analog: Five-conductor (plus two isolated shields) cable with XLPE (cross-linked polyethylene) jacket; rated to 150 °C (302 °F); 6 m (20 ft) standard length
Components	Corrosion-resistant materials, fully-immersible probe with 10 m (30 ft) cable	Corrosion-resistant materials, fully-immersible probe with 10 m (30 ft) cable	Corrosion-resistant materials, fully-immersible probe with 10 m (30 ft) cable
Measuring Range	–2.0 to 14.0 pH or –2.00 to 14.00 pH	–2.0 to 14.0 pH or –2.00 to 14.00 pH	–1500 to +1500 mV
Probe Storage Temperature	4 to 70 °C (40 to 158 °F); 0 to 95% relative humidity, non-condensing	4 to 70 °C (40 to 158 °F); 0 to 95% relative humidity, non-condensing	4 to 70 °C (40 to 158 °F); 0 to 95% relative humidity, non-condensing

Table 1 Differential pH and ORP Sensor Specifications (continued)

Specification Category	pH Sensors[1]	Stainless Steel pH Sensor	ORP Sensors[2]
Temperature Compensation	Automatic from –10 to 105 °C (14.0 to 221 °F) with selection for NTC 300 ohm thermistor, Pt 1000 ohm RTD, or Pt 100 ohm RTD temperature element, or manually fixed at a user-entered temperature; additional selectable temperature correction factors (ammonia, morpholine, or user-defined pH/°C linear slope) available for pure water automatic compensation from 0.0 to 50 °C (32 to 122 °F)	Automatic from –10 to 105 °C (14.0 to 221 °F) with selection for NTC 300 ohm thermistor, Pt 1000 ohm RTD, or Pt 100 ohm RTD temperature element, or manually fixed at a user-entered temperature; additional selectable temperature correction factors (ammonia, morpholine, or user-defined pH/°C linear slope) available for pure water automatic compensation from 0.0 to 50 °C (32 to 122 °F)	N/A
Measurement Accuracy	±0.02 pH	±0.02 pH	±5 mV
Temperature Accuracy	±0.5 °C (0.9 °F)	±0.5 °C (0.9 °F)	±0.5 °C (0.9 °F)
Repeatability	±0.05 pH	±0.05 pH	±2mV
Sensitivity	±0.01 pH	±0.01 pH	±0.5 mV
Calibration Methods	Two point automatic, one point automatic, two point manual, one point manual.	Two point automatic, one point automatic, two point manual, one point manual.	one point manual
Maximum Probe Immersion Depth/ Pressure	Submersible to 107 m (350 ft)/1050 kPa (150 psi)	Immersion only	Submersible to 107 m (350 ft)/1050 kPa (150 psi)
Sensor Interface	Modbus	Modbus	Modbus
Probe Cable Length	6 m (20 ft) + 7.7 m (25 ft) interconnect cable extension for analog sensor with digital gateway 10 m (31 ft) for sensor with integral digital electronics	6 m (20 ft) + 7.7 m (25 ft) interconnect cable extension for analog sensor with digital gateway 10 m (31 ft) for sensor with integral digital electronics	6 m (20 ft) + 7.7 m (25 ft) interconnect cable extension for analog sensor with digital gateway 10 m (31 ft) for sensor with integral digital electronics
Probe Weight	316 g (11 oz)	870 g (31 oz)	316 g (11 oz)
Probe Dimensions	See Figure 2 on page 9 through Figure 3 on page 9.	See Figure 4 on page 9.	See Figure 2 on page 9 through Figure 3 on page 9.

[1] Most pH applications are in the 2.5 to 12.5 pH range. The pHD™ Differential pH sensor with the wide-range glass process electrode performs exceptionally well in this range. Some industrial applications require accurate measurement and control below 2 or above 12 pH. In these special cases, please contact the manufacturer for further details.

[2] For best ORP measuring results in solutions containing zinc, cyanide, cadmium or nickel, the manufacturer recommends using the pHD™ ORP sensor equipped with a gold electrode.

[3] PEEK® is a registered trademark of ICI Americas, Inc.

[4] Ryton® is a registered trademark of Phillips 66 Co.

[5] Kynar® is a registered trademark of Pennwalt Corp.

[6] Viton® is a registered trademark of E.I. DuPont de Nemours + Co.

Table 2 Digital Gateway Specifications

Weight	145 g (5 oz)
Dimensions	17.5 x 3.4 cm (7 x 1 3/8 in.)
Operating Temperature	–20 to 60 °C (–4 to 140°F)

Section 2 General Information

2.1 Safety Information

Please read this entire manual before unpacking, setting up, or operating this equipment. Pay attention to all danger and caution statements. Failure to do so could result in serious injury to the operator or damage to the equipment.

To ensure that the protection provided by this equipment is not impaired, do not use or install this equipment in any manner other than that specified in this manual.

This product is acceptable for use in a Hazardous Location when used with an sc100 Controller and installed per Control Drawing 58600-78 as described in the sc100 Controller Manual, Cat. No. 5860018.

2.1.1 Use of Hazard Information

DANGER
Indicates a potentially or imminently hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION
Indicates a potentially hazardous situation that may result in minor or moderate injury.

Important Note: *Information that requires special emphasis.*

Note: *Information that supplements points in the main text.*

2.1.2 Precautionary Labels

Read all labels and tags attached to the instrument. Personal injury or damage to the instrument could occur if not observed.

	This symbol, if noted on the instrument, references the instruction manual for operation and/or safety information.
	This symbol, when noted on a product enclosure or barrier, indicates that a risk of electrical shock and/or electrocution exists.
	This symbol, if noted on the product, indicates the need for protective eye wear.
	This symbol, when noted on the product, identifies the location of the connection for Protective Earth (ground).
	This symbol, when noted on the product, identifies the location of a fuse or current limiting device.

2.2 General Sensor Information

Optional equipment, such as mounting hardware for the probe, is supplied with instructions for all user installation tasks. Several mounting options are available, allowing the probe to be adapted for use in many different applications.

The electronics of the sensor are encapsulated in a PEEK® or Ryton® body. The pH sensor has an integral NTC 300 ohm thermistor to automatically compensate pH readings for temperature changes. ORP sensors have a fixed temperature value of 25 °C/300 ohm (the ORP measurement is not temperature dependent).

2.2.1 Sensor Body Styles

pHD™ Differential pH and ORP sensors are available in three body styles:

- **Convertible Body Style** — has 1-inch NPT threads at both ends of the body for mounting in any of the following configurations:
  - into a standard 1-inch NPT pipe tee
  - into a pipe adapter for union mounting with a standard 1-½ inch pipe tee
  - onto the end of a pipe for immersion into a vessel

Note: *The convertible style sensor can also be retrofitted into existing installations for 1-½ inch LCP, Ryton, and epoxy sensors.*

- **Insertion Body Style** — similar to the convertible sensor except that its 1-inch NPT threads are only on the cable end for mounting into a flow cell or the pipe adapter of a ball valve hardware assembly. This hardware enables the sensor to be inserted into or retracted from the process without stopping the process flow.
- **Sanitary Body Style** — features a built-in 2-inch flange for mounting into a 2-inch sanitary tee. Included with the sanitary-style sensor is a special cap and EDPM compound gasket for use with the sanitary hardware.

In addition, all probes are available with or without integral digital electronics. For applications with extreme temperatures, the sensor without integral digital electronics can be combined with the digital gateway.

Figure 1 Convertible Style Sensor Dimensions

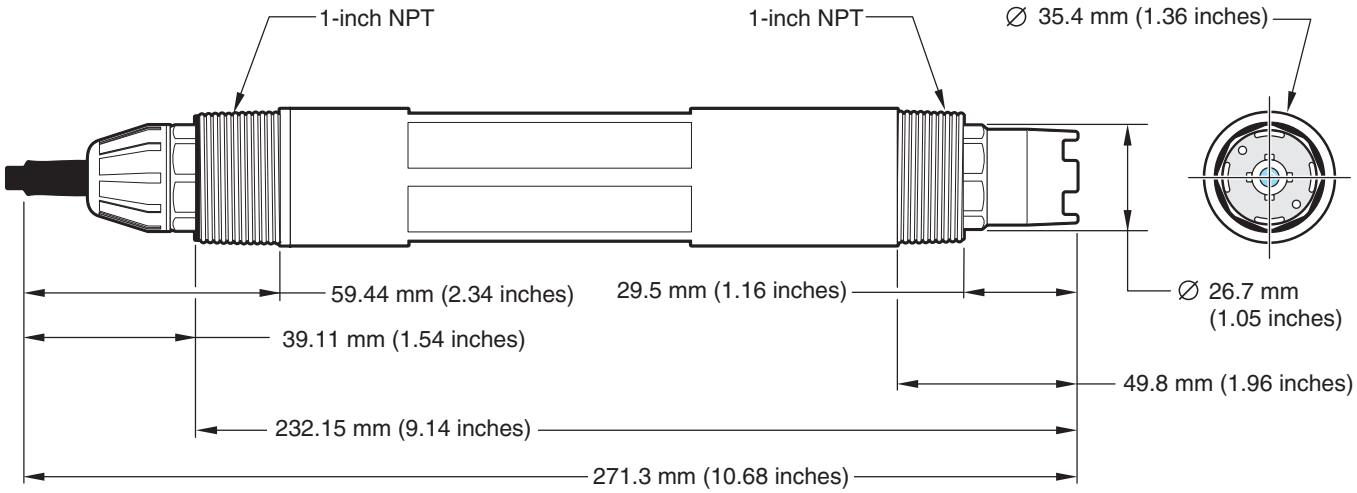


Figure 2 Insertion Style Sensor Dimensions

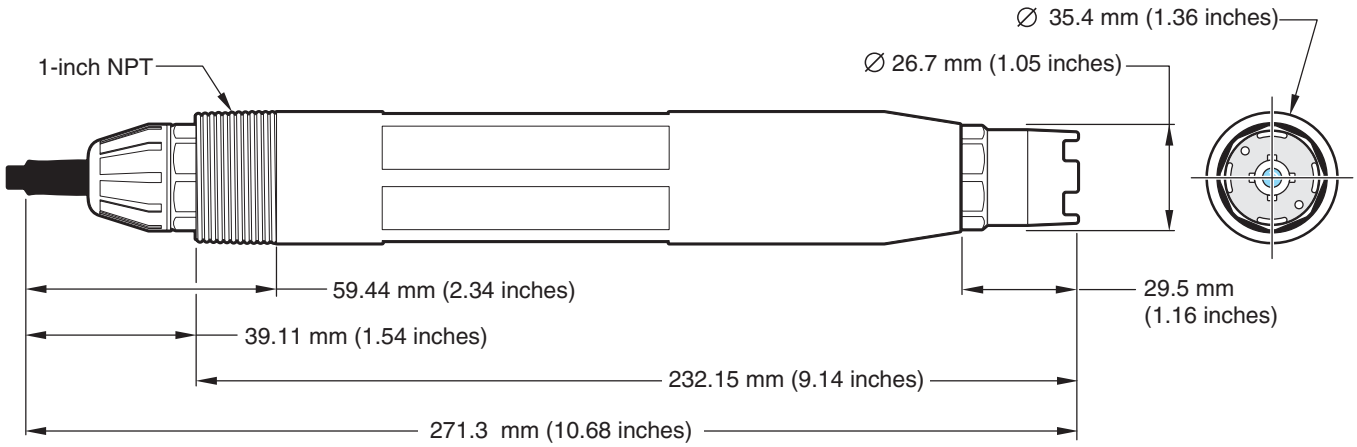


Figure 3 Sanitary Style Sensor Dimensions

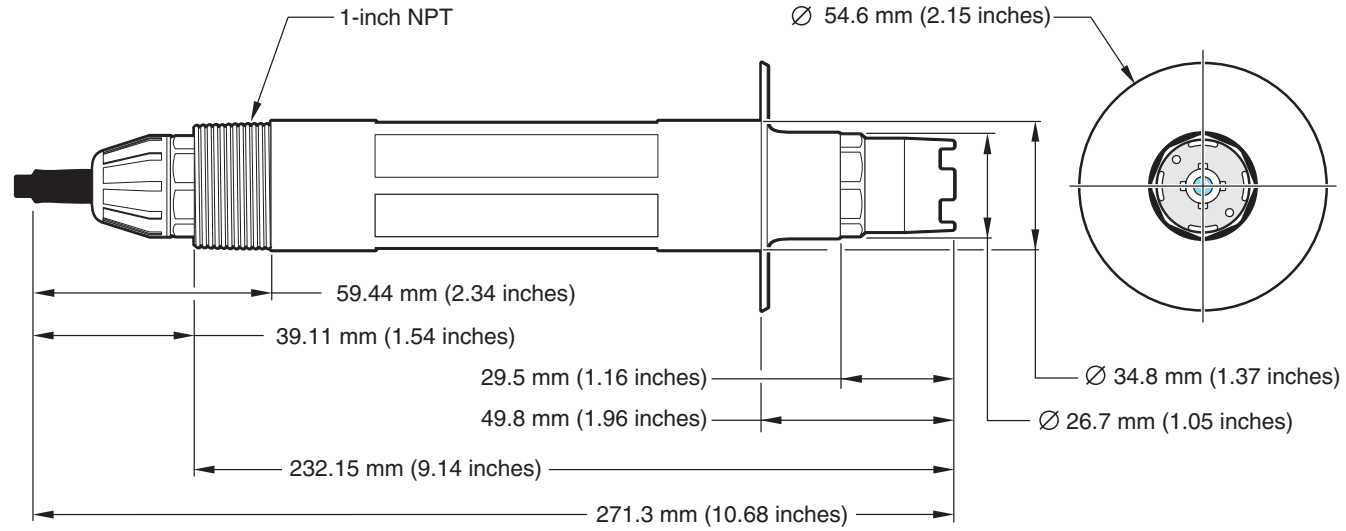
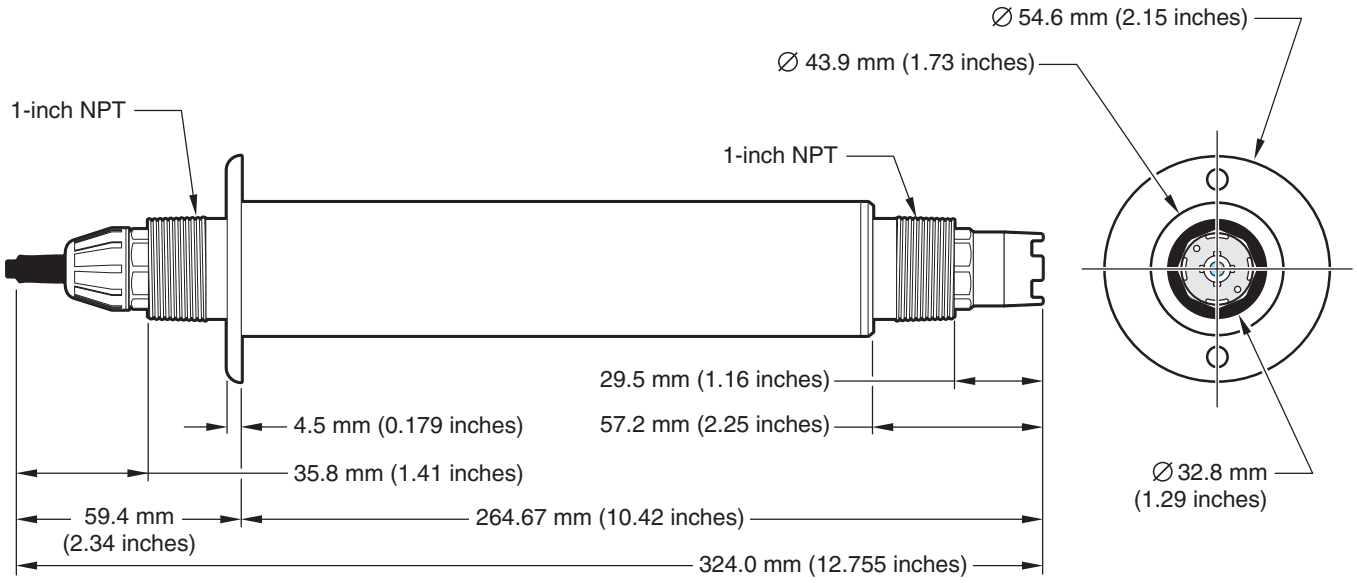


Figure 4 Stainless Steel Style Sensor (DPS1 and DRS5) Dimensions



2.3 The Digital Gateway

The digital gateway was developed to provide a means to use existing analog sensors with the new digital controllers. The gateway contains all the necessary software to interface with the controller and output a digital signal. Extension cables are required for connection from the digital gateway to the digital controller. See Replacement Parts and Accessories on page 41.

2.4 Operating Precaution

CAUTION
If the pH process electrode breaks, handle the sensor very carefully to prevent injury.

Before placing the pH or ORP sensor into operation, remove the protective cap to expose the process electrode and salt bridge. Save the protective cap for future use.

For short-term storage (when sensor is out of the process for more than one hour) fill the protective cap with pH 4 buffer or DI water and place the cap back on the sensor. Keeping the process electrode and salt bridge moist will avoid slow response when the sensor is placed back in operation.

For extended storage, repeat the short-term storage procedure every 2 to 4 weeks, depending on the surrounding environmental conditions. See Specifications on page 5 for temperature storage limits.

The process electrode at the tip of the pH sensor has a glass bulb, which can be broken. Do not subject it to abrupt impact or other mechanical abuse.

The gold or platinum process electrode at the ORP sensor tip has a glass shank (hidden by the salt bridge) which can break. Do not subject this electrode to impact or other mechanical abuse.

DANGER
Only qualified personnel should conduct the tasks described in this section of the manual.

DANGER
Seul un technicien qualifié peut effectuer les tâches d'installation décrites dans cette section du manuel.

3.1 Connecting/Wiring the Sensor to the sc100 Controller

DANGER
The sc100 and certain versions of the sensor are suitable for use in Class 1, Division 2, Groups A, B, C, D Hazardous Locations . See Control Drawing 58600-78 in the sc100 Controller Manual, Cat. No. 58600-18 for acceptable sensor versions and installation requirements.

DANGER
Le sc100 et certaines versions du capteur peuvent être utilisés dans des endroits dangereux de la Classe 1, Division 2, Groupes A, B, C, D. Reportez-vous au schéma de contrôle 58600-78 du Manuel du contrôleur sc100, Réf. 58600-18 pour connaître les versions des capteurs admises et les conditions d'installation.

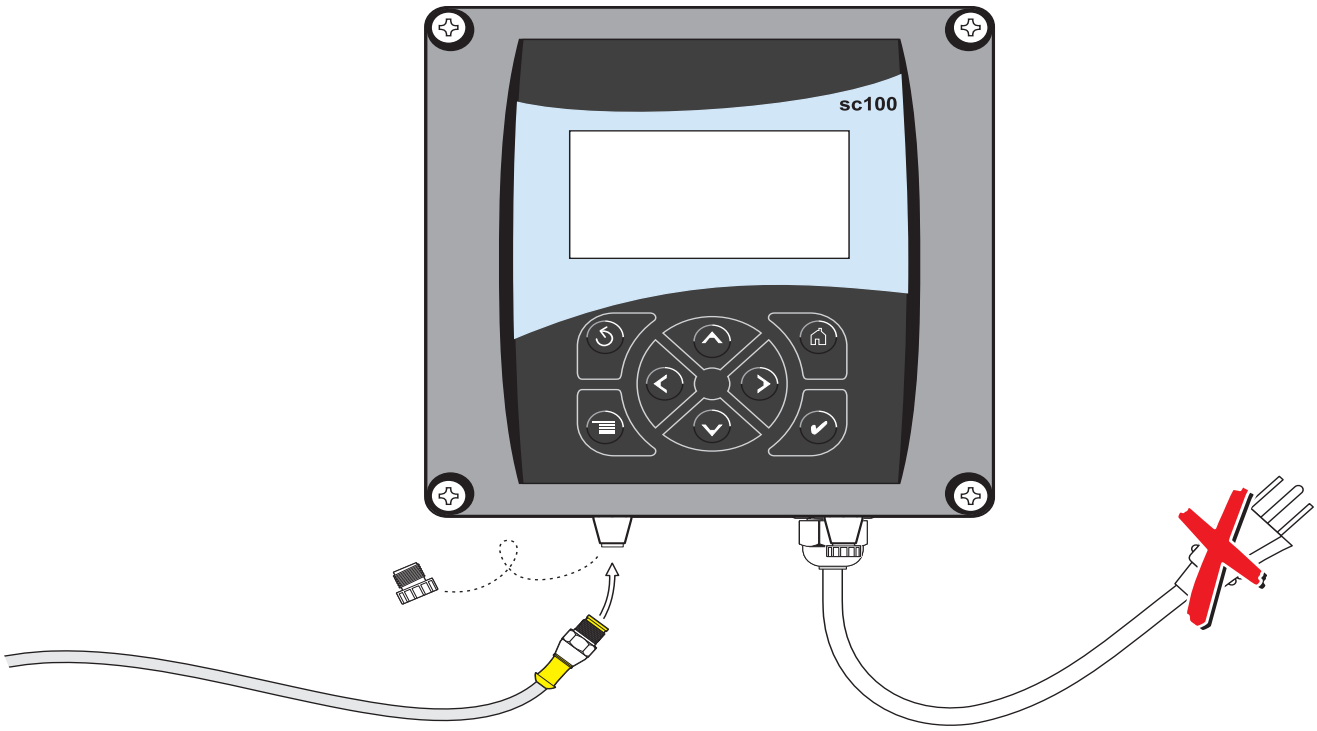
3.1.1 Connecting the sc Sensor to a sc100 Controller in a Non-hazardous Location

3.1.1.1 Attaching a sc Sensor with a Quick-connect Fitting

Important Note: *The standard quick-connect fitting is NOT suitable for Class 1, Division 2 Hazardous Location installations without the connector lock installed, see section 3.1.2 on page 13 for more information.*

The sensor has a keyed quick-connect fitting for easy attachment to the controller (Figure 5). Retain the connector cap to seal the connector opening when the sensor is removed. Extension cables may be purchased to extend the sensor cable length. If the total cable length exceeds 100 m (300 ft), a termination box must be installed. See Replacement Parts and Accessories on page 41.

Figure 5 Attaching the Sensor using the Quick-connect Fitting



3.1.1.2 Hard-wiring a sc Sensor to the Controller

Important Note: *Hard-wiring the sensor to the sc100 is not an approved method for Class I, Division 2 Hazardous Locations.*

1. Disconnect power to the controller if powered.
2. Open the controller cover.
3. Disconnect and remove the existing wires between the quick-connect and terminal strip J5, see Figure 5 on page 12.
4. Remove the quick-connect fitting and wires and install the threaded plug on the opening to maintain the environmental rating.
5. Cut the connector from the sensor cable.
6. Strip the insulation on the cable back 1-inch. Strip ¼-inch of each individual wire end.
7. Pass the cable through conduit and a conduit hub or a strain relief fitting (Cat.No.16664) and an available access hole in the controller enclosure. Tighten the fitting.

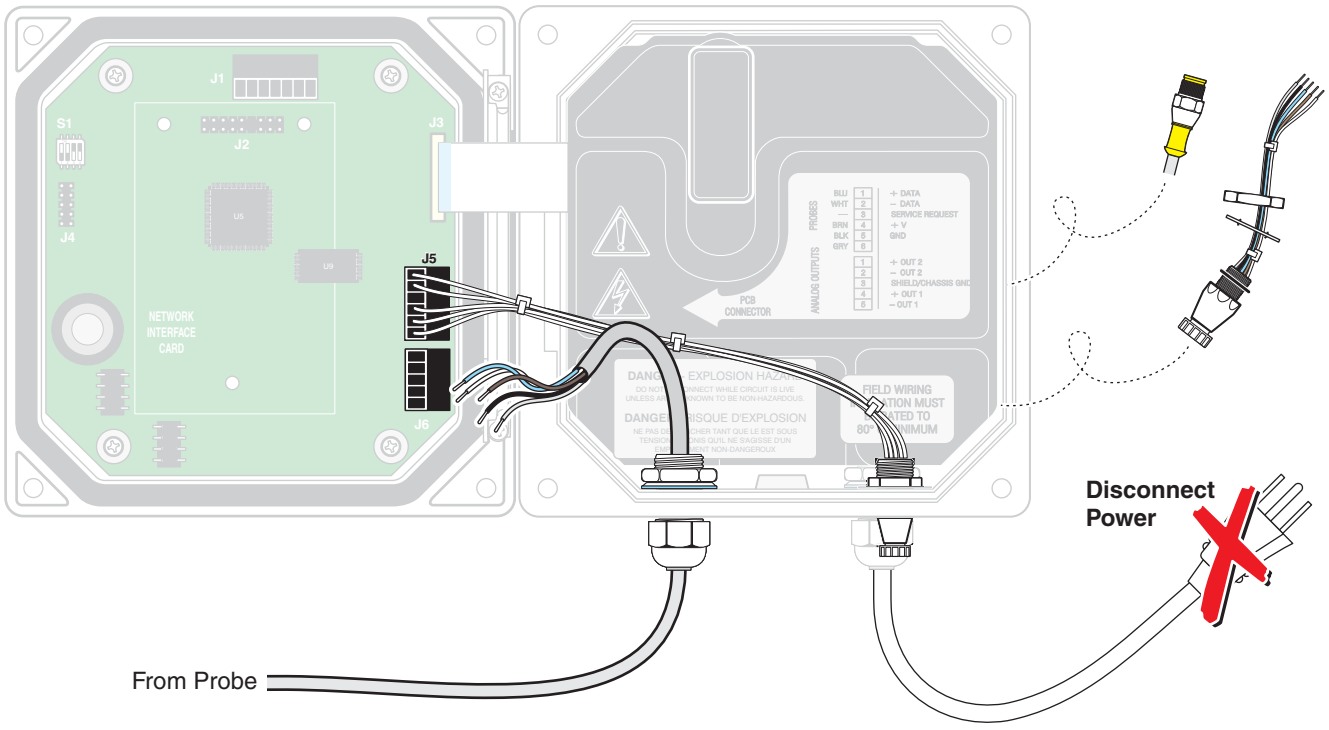
Note: *Use of strain relief fitting other than Cat. No. 16664 may result in a hazard. Use only the recommended strain relief fitting.*

8. Reinstall the plug on the sensor access opening to maintain the environmental rating.
9. Wire as shown in Table 3 and Figure 6.
10. Close and secure the cover.

Table 3 Wiring the Sensor at Terminal Block J5

Terminal Number	Terminal Designation	Wire Color
1	Data (+)	Blue
2	Data (–)	White
3	Service Request	No Connection
4	+12 V dc	Brown
5	Circuit Common	Black
6	Shield	Shield (grey wire in existing quick disconnect fitting)

Figure 6 Hard-wiring the sensor



3.1.2 Connecting the sc Sensor to a sc100 Controller in a Hazardous Location

DANGER
The sc100 and certain versions of the sensor are suitable for use in Class 1, Division 2, Groups A, B, C, D Hazardous Locations. See Control Drawing 58600-78 in the sc100 Controller Manual, Cat. No. 58600-18 for acceptable sensor versions and installation requirements.

DANGER
Le sc100 et certaines versions du capteur peuvent être utilisés dans des endroits dangereux de la Classe 1, Division 2, Groupes A, B, C, D. Reportez-vous au schéma de contrôle 58600-78 du Manuel du contrôleur sc100, Réf. 58600-18 pour connaître les versions des capteurs admises et les conditions d'installation.

DANGER
Explosion hazard. Do not connect or disconnect equipment unless power has been switched off or the area is known to be non-hazardous.

DANGER
Risque d'explosion. Couper le courant ou s'assurer que l'emplacement est designe non dangereux avant de replacer le aucon composant.

3.1.2.1 Attaching a sc Sensor with a Quick-connect Fitting in a Hazardous Location

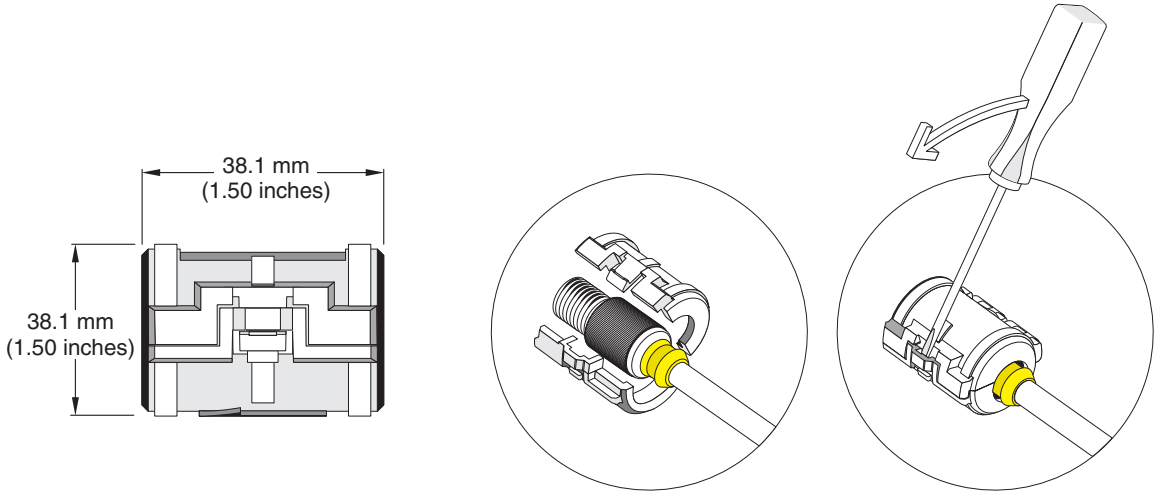
The sensor cable is supplied with a keyed quick-connect fitting for easy attachment to the controller, see Figure 5. For hazardous locations, a connector safety lock (Cat. No. 6139900) **must** be installed. Retain the connector cap to seal the connector opening in case the sensor must be removed.

1. Remove the connector cap from sc100 controller. Retain the connector cap to seal the connector opening in case the sensor must be removed.

2. Connect the sensor connector to the plug on the sc100.

3. Install a connector safety lock (Figure 7). Align the lock over the connector and squeeze the two halves together to lock. To remove the connector safety lock by inserting a small flat-bladed screwdriver into the locking groove. Pivot the screwdriver away from the groove and separate the two halves (Figure 7).

Figure 7 Installing the Connector Safety Lock



3.2 Connecting the Sensor to the sc1000

3.2.1 Connecting the Sensor using the Quick-connect Fittings

1. Unscrew the connector cap from the controller. Retain the connector cap to seal the connector opening in case the sensor must be removed.

2. Push the connector into the socket.

3. Hand-tighten the union nut.

Note: *Do not use the middle connection for the sensors as this is reserved for the display module.*

3.3 Using the Digital Gateway

The digital gateway is designed to provide a digital interface to the controller. The non-sensor end is wired to the sc100 or sc1000 controller in a non-hazardous location as

shown in section 3.1.1 on page 11. The non-sensor end is wired to the sc100 controller in a hazardous location as shown in section 3.1.2 on page 13.

3.3.1 Wiring the Digital Gateway

DANGER
The sc100 and certain versions of the sensor are suitable for use in Class 1, Division 2, Groups A, B, C, D Hazardous Locations . See Control Drawing 58600-78 in the sc100 Controller Manual, Cat. No. 58600-18 for acceptable sensor versions and installation requirements.

DANGER
Le sc100 et certaines versions du capteur peuvent être utilisés dans des endroits dangereux de la Classe 1, Division 2, Groupes A, B, C, D. Reportez-vous au schéma de contrôle 58600-78 du Manuel du contrôleur sc100, Réf. 58600-18 pour connaître les versions des capteurs admises et les conditions d'installation.

DANGER
Explosion hazard. Do not connect or disconnect equipment unless power has been switched off or the area is known to be non-hazardous.

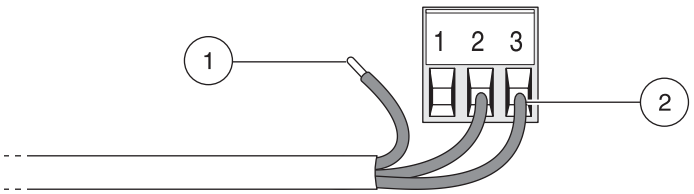
DANGER
Risque d'explosion. Couper le courant ou s'assurer que l'emplacement est designe non dangereux avant de replacer le aucon composant.

1. Route the cable from the sensor through the strain relief in the digital gateway then properly terminate the wire ends (see Figure 8).

Note: *Do not tighten the strain relief until the digital gateway is wired and the two halves are threaded securely together.*

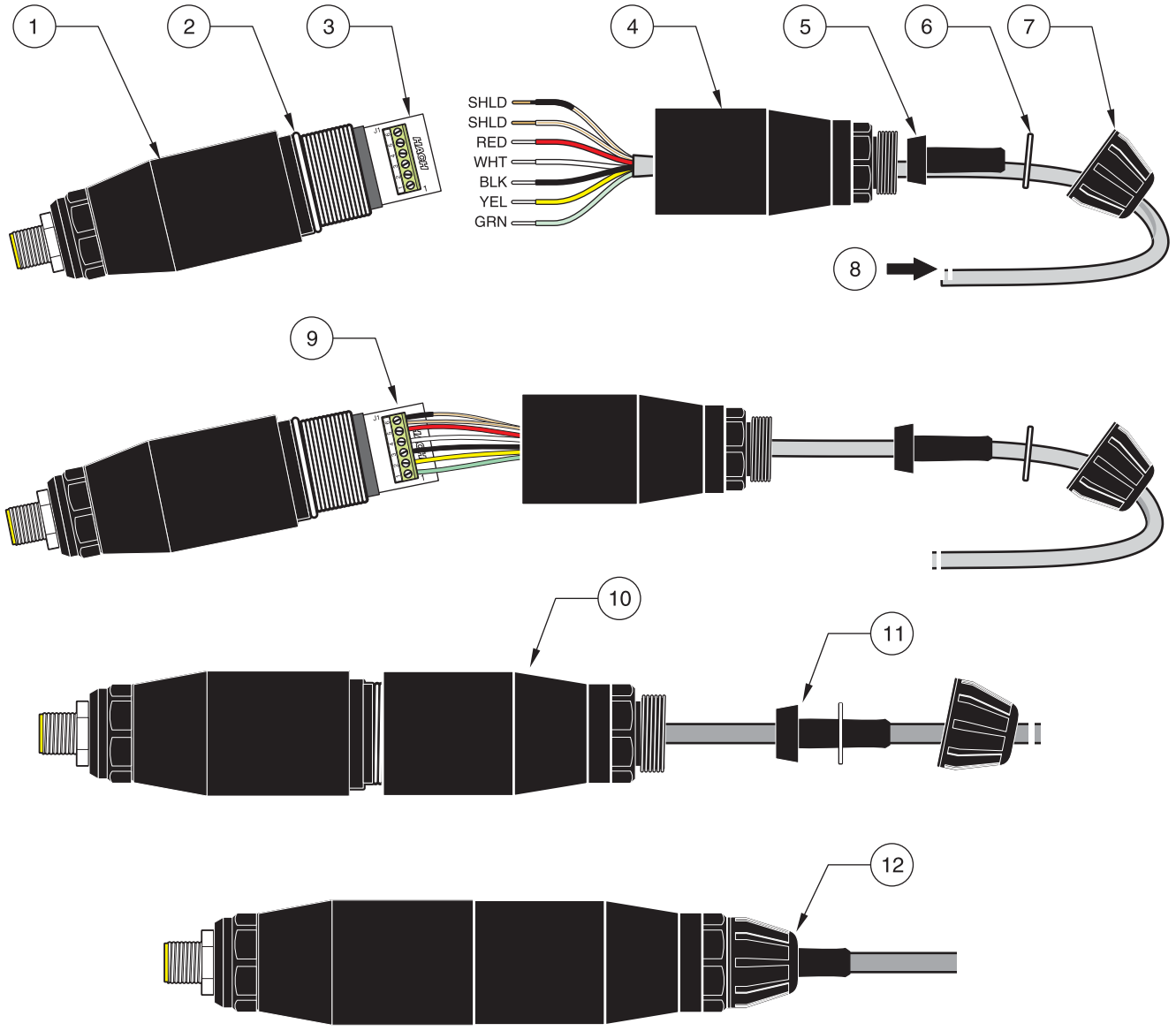
2. Insert the wires as shown in Table 4 and Figure 9.
3. Make sure the O-ring is properly installed between the two halves of the digital gateway and thread the two halves together. Hand tighten.
4. Tighten the strain relief to secure the sensor cable.
5. Connect the digital gateway to the controller.
   - sc100 Non-Hazardous Location Instructions—section 3.1.1 on page 11.
   - sc100 Hazardous Location Instructions—section 3.1.2 on page 13g
   - sc1000 Connection Instructions—Refer to section 3.2 on page 14.

Figure 8 Proper Wire Preparation and Insertion



1. Strip ¼-inch of insulation.	**1.** Seat insulation against connector with no bare wire exposed.

Figure 9 Wiring and Assembling the Digital Gateway



1.	Digital gateway front	**7.**	Cord grip
2.	O-ring	**8.**	From sensor
3.	Sensor wire connector	**9.**	Insert wires into connector according to Table 4. Use the included 2 mm screwdriver (Cat. No. 6134300) to secure connections.
4.	Digital gateway back	**10.**	Screw back of digital gateway onto front.
5.	Cable bushing	**11.**	Push cable bushing and anti-rotation washer into back.
6.	Anti-rotation washer	**12.**	Fasten cord grip securely. Assembly is complete.

Table 4 Wiring the Digital Gateway (Cat. No. 6120500)

Sensor (wire color)	Sensor Signal	Digital Gateway J1
Green	Ref	J1-1
Yellow	Temp +	J1-2
Black	Temp –	J1-3
White	VI	J1-4
Red	Active	J1-5
Clear	Shield	J1-6
Clear w/shrink wrap	Shield	J1-6

3.3.2 Mounting the Digital Gateway

The digital gateway is supplied with a mounting clip for mounting to a wall or other flat surface. See Figure 10 for dimensions. Use an appropriate fastener to secure it to the wall, see Figure 11. After the sensor is wired to the digital gateway and the two halves are threaded together, place the mounting clip over the center of the digital gateway and squeeze the clip together to secure.

Figure 10 Digital Gateway Dimensions

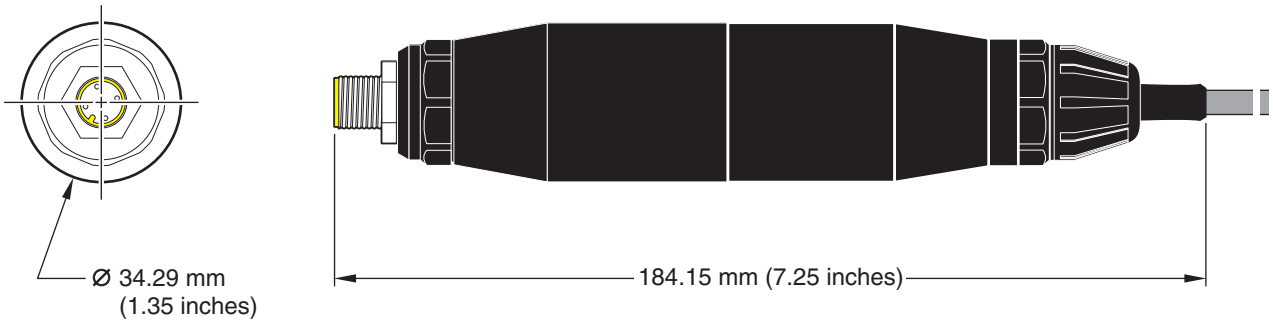
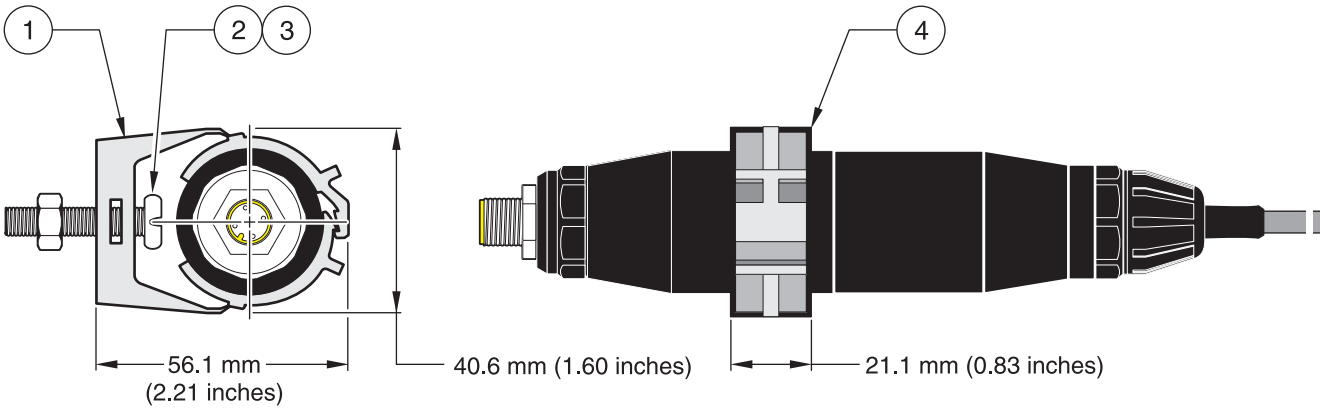


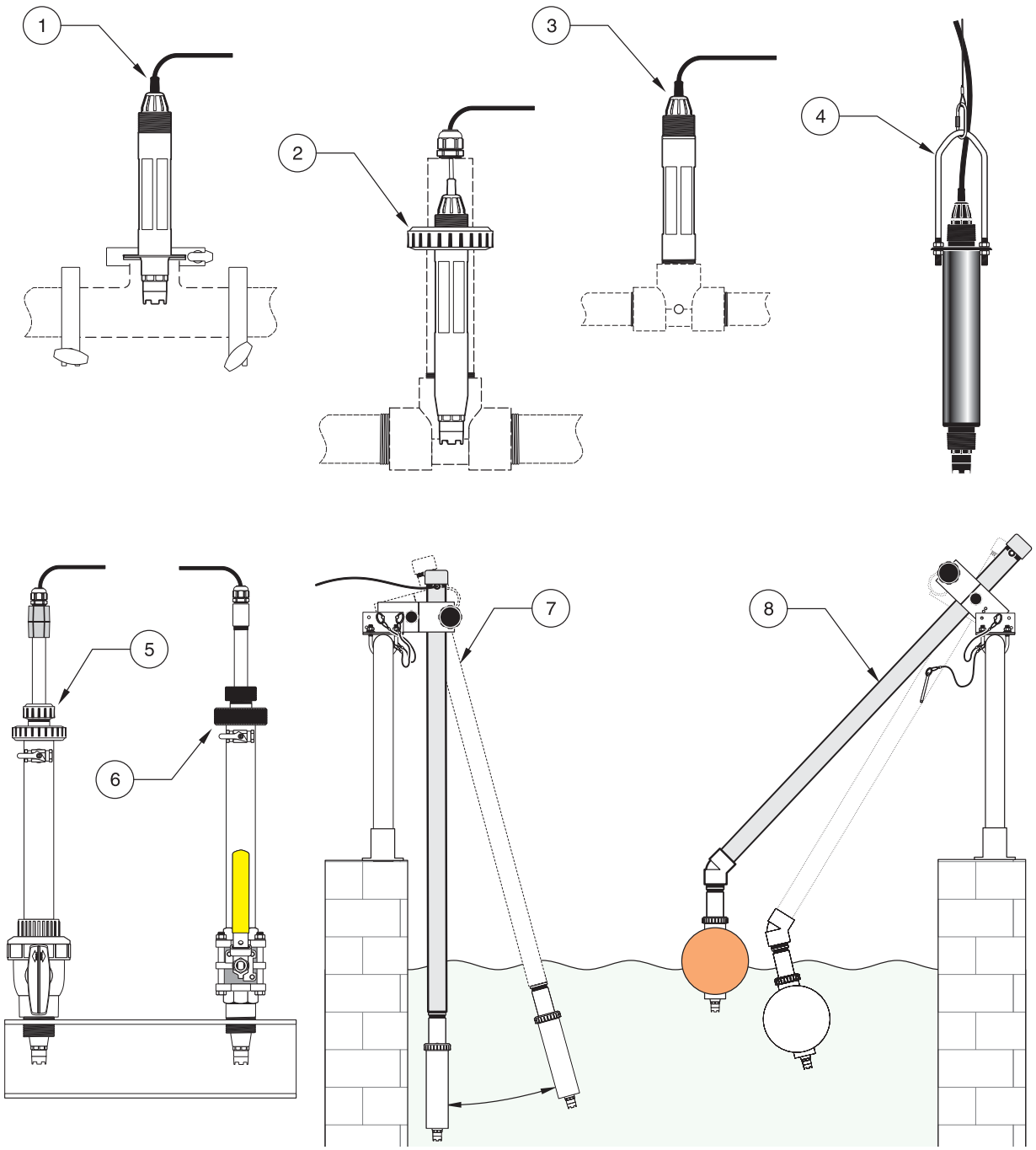
Figure 11 Mounting the Digital Gateway



1. Mounting Clip	**14.** Hex Nut, ¼-28
13. Screw, pan head, ¼-28 x 1.25-in.	**15.** Mount clip, insert digital gateway, squeeze clip closed.

3.4 Installing the Sensor in the Sample Stream

Figure 12 Sensor Installation Examples

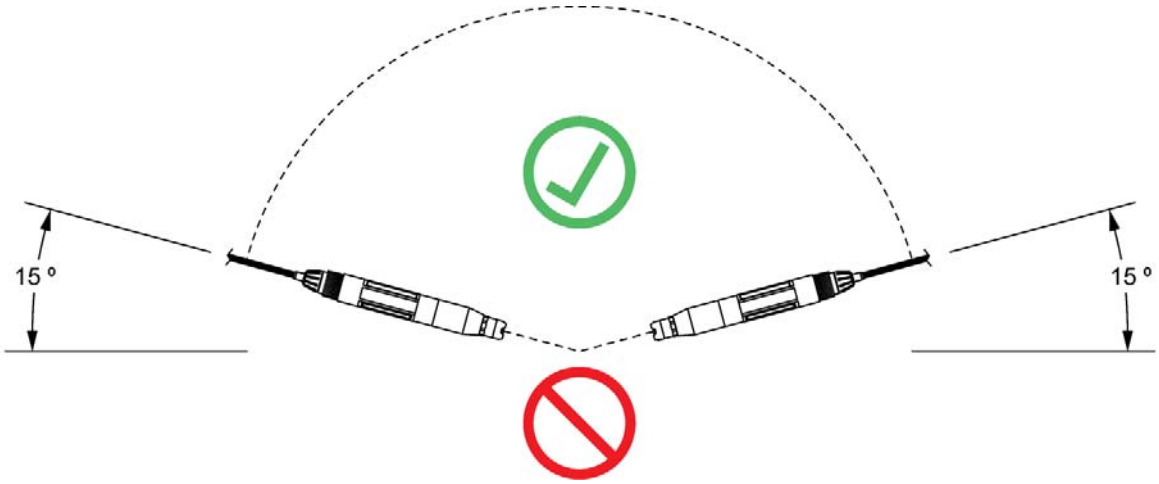


1. Sanitary mount	**19.** PVC Insertion mount
16. Union mount	**20.** Stainless steel insertion mount
17. Flow-through mount	**21.** Immersion mount
18. Hanging stainless steel sensor with the bale	**22.** Immersion mount, ball float

- Install the sensor so the sample contacts is representative of the entire process.
- Mount the sensor at least 508 mm (20 in) from the aeration basin wall, and immerse it at least 508 mm (20 in) into the process.

- Install the sensor using the instructions supplied with the installation apparatus. See Figure 12 for suggested mounting configurations.
- Sensor must be mounted at least 15º above horizontal. See Figure 13.

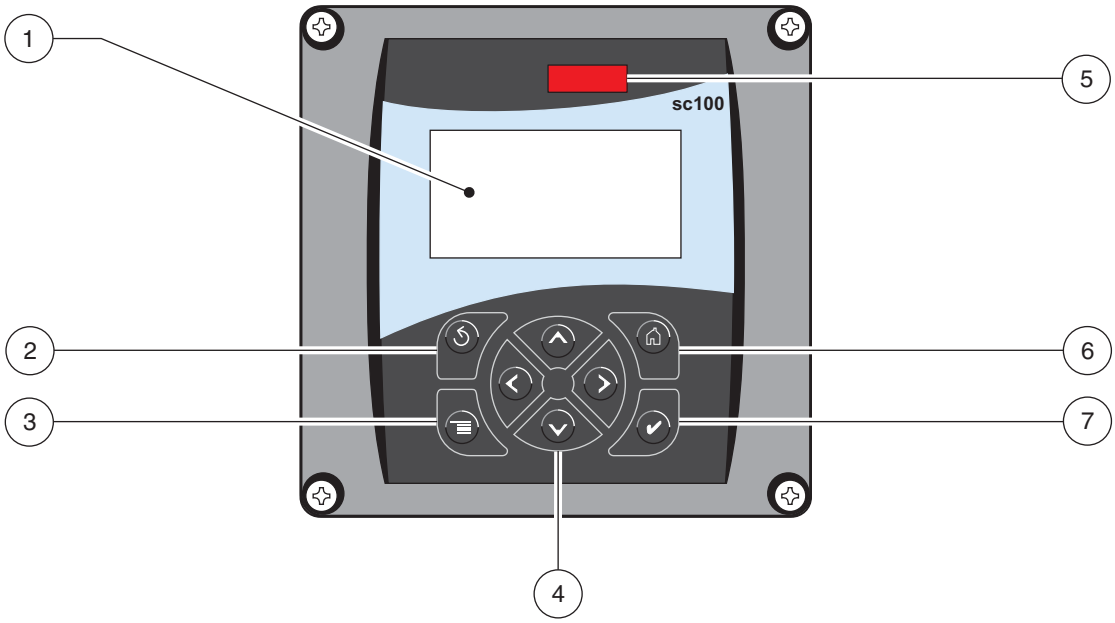
Figure 13 Sensor Mounting Angle



4.1 Using the sc100 Controller

The front of the controller is shown in Figure 14. The keypad consists of the eight keys described in Table 5.

Figure 14 Front of the Controller



1. Instrument display	**26.** IrDA window
23. BACK key	**27. HOME** key
24. MENU key	**28. ENTER** key
25. RIGHT, **LEFT**, **UP**, and **DOWN** keys	

Table 5 Controller Key Functions/Features

Number	Key	Function
2	back	Moves back one level in the menu structure.
3	menu	Moves to the main menu from other menus. This key is not active in menus where a selection or other input must be made.
4		Navigates through the menus, changes settings, and increments and decrements digits.
5	home	Moves to the Main Measurement screen from any other screen. This key is not active in menus where a selection or other input must be made.
6	enter	Accepts an input value, updates, or accepts displayed menu options.

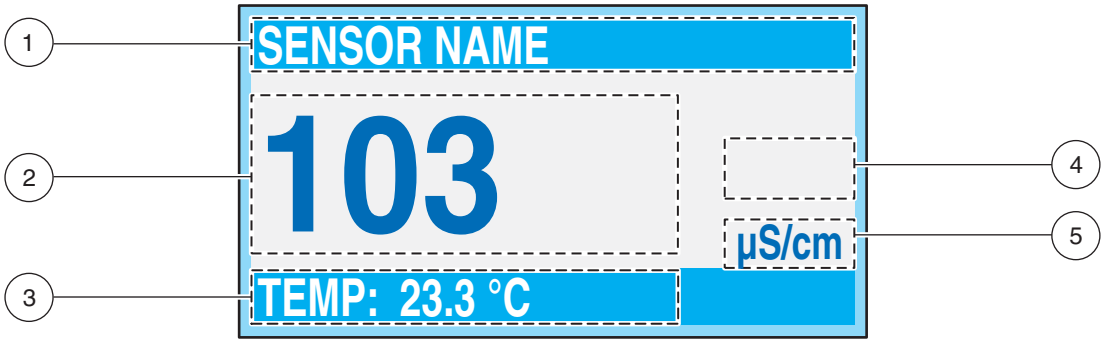
4.1.1 Controller Display Features

When a sensor is connected and the controller is in measurement mode, the controller display will show the current conductivity reading plus the sample temperature.

The display will flash on startup, when a sensor error has occurred, when the hold outputs function has been activated, and when a sensor is being calibrated.

An active system warning will cause the warning icon (a triangle with an exclamation point inside) to be displayed on the right side of the display.

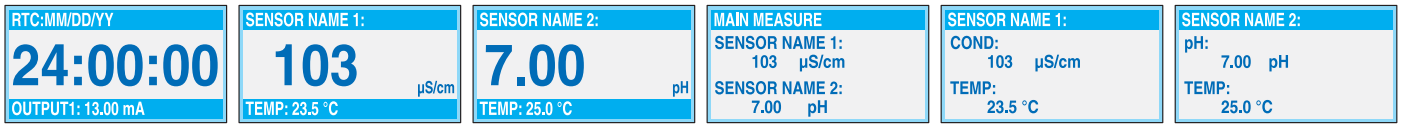
Figure 15 Display



1. Status bar. Indicates the sensor name and status of relays. The relay letter is displayed when the relay is energized.	**30.** Secondary measurement
	31. Warning icon area
29. Main measurement	**32.** Measurement units (µS, mS, S, mohm, TDS)

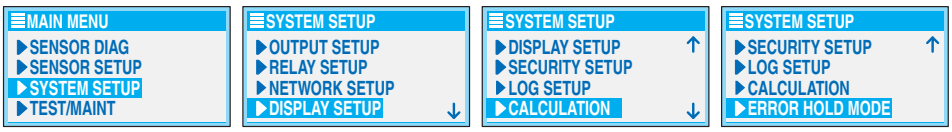
4.1.2 Important Key Presses

- Press the **HOME** key then the **RIGHT** or **LEFT** key to display two readings when two sensors are connected. Continue to press the **RIGHT** or **LEFT** key to toggle through the available display options as shown below.



- Press the **UP** and **DOWN** keys to toggle the status bar at the bottom of the measurement display to display the secondary measurement (temperature) and output information.

- When in Menu mode, an arrow may appear on the right side of the display to indicate that more menus are available. Press the **UP** or **DOWN** key (corresponding to the arrow direction) to display additional menus.



4.2 Using the sc1000 Controller

The sc1000 is a touch screen application. Use your finger to touch keys and menu commands. In normal operation the touch screen displays the measured values for the sensors selected.

4.2.1 Display Features

4.2.1.1 Using the Pop-up Toolbar

The pop-up toolbar provides access to the controller and sensor settings. The toolbar is normally hidden from view. To view the toolbar, touch the bottom-left of the screen.

Figure 16 Pop-up Toolbar Functions

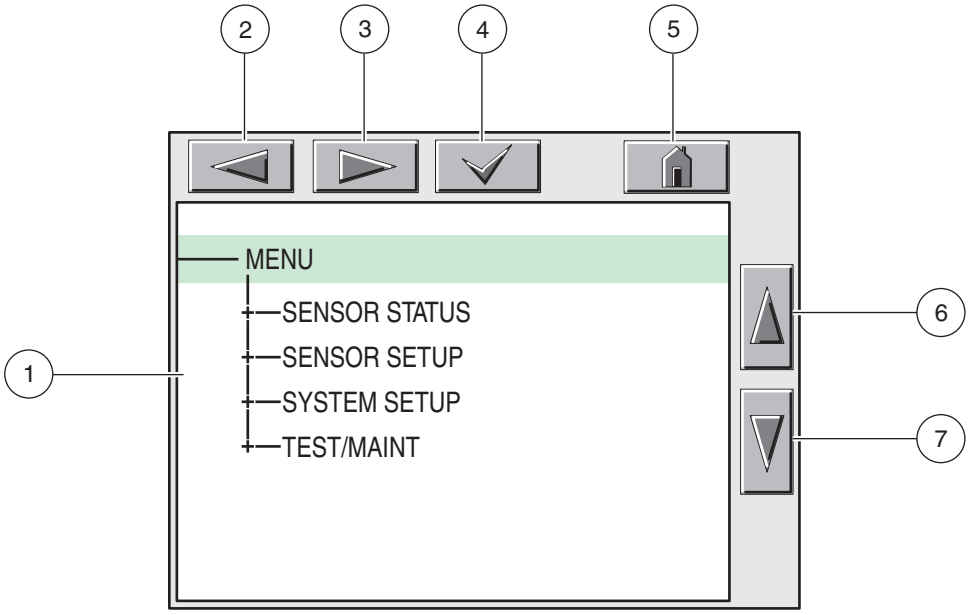
	**MAIN MENU**–displays the Main Menu Structure
	**UP** Arrow–scrolls up to the previous displayed value.
	Displays one value.
	Displays two values at the same time.
	Displays four values at the same time.
	**LIST**–displays the list of connected devices and sensors.
	**DOWN** Arrow–scrolls down to the next displayed value.

4.2.1.2 Using the Menu Windows

If the Menu button (from the pop-up toolbar) is selected, the Main Menu screen is opened. The Main Menu screen allows the user to view the sensor status, configure the sensor setup, system setup, and perform diagnostics.

The menu structure may vary depending on the configuration of the system.

Figure 17 Main Menu



1.	Display Area
33.	**BACK**
34.	**FORWARD**
35.	**ENTER**–confirms the entry or selection.
36.	**HOME**–changes to the display of measured values. The pop-up toolbar cannot open from the menu window. To view the Main Menu from this display, touch the Home button and then the bottom of the screen.
37.	**UP**–scrolls up
38.	**DOWN**–scrolls down

4.2.1.3 Navigating the Menu Windows

To view a menu item, touch the menu item or use the **UP** and **DOWN** keys to highlight the item. The menu item remains highlighted for approximately 4 seconds after it is selected. To view the highlighted command, select the area to the left of the menu item or select the **ENTER** button.

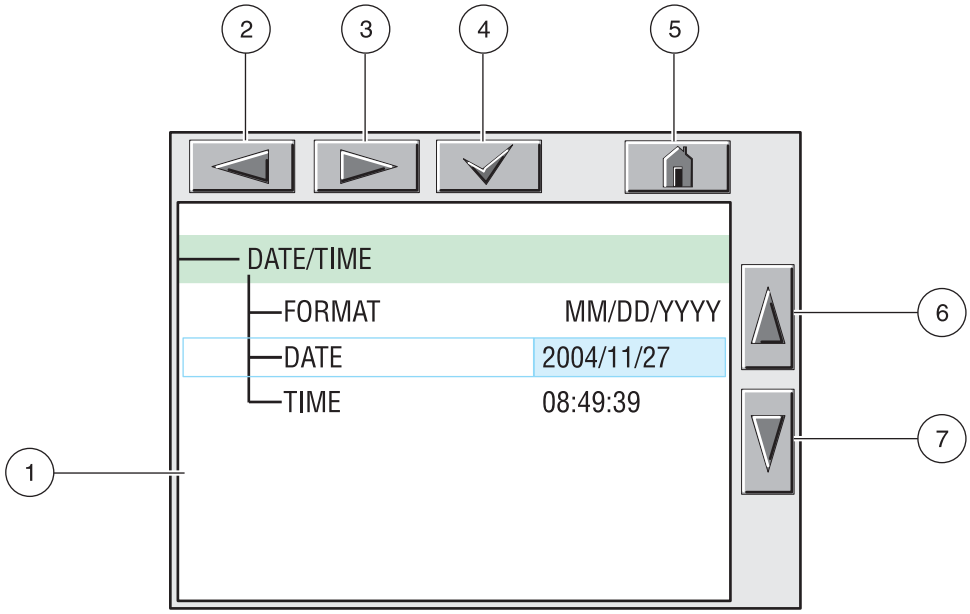
A "**+**" next to a menu command indicates there is a submenu. Touch the "+" to view the submenu. An "**i**" next to a menu command indicates it is information only.

If a menu item is editable, highlight the item and touch the far-left part of the menu item until it is highlighted and press **ENTER** or double-tap the highlighted item. A keypad will be displayed to change an entry (Figure 19 on page 25) or a list box will be displayed (Figure 20 on page 26).

Messages are displayed in the message window (Figure 21 on page 26).

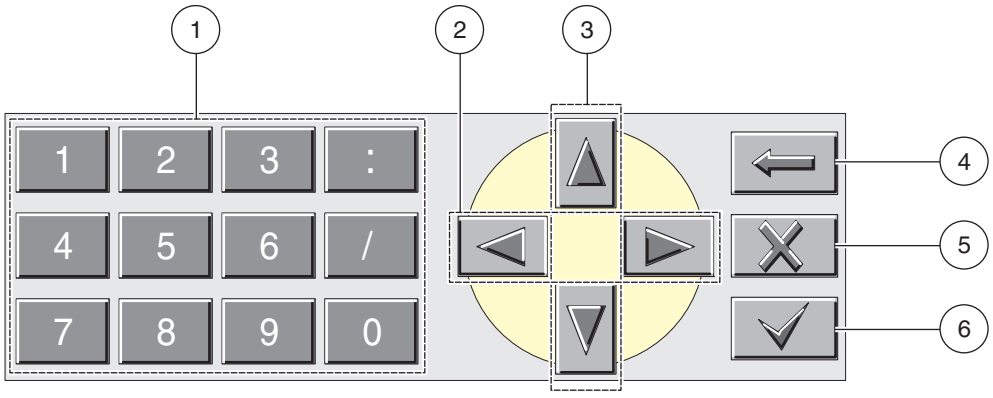
If an entry is incorrect, repeat the entry with the correct values. If the entry is outside the working range, a correction to the entry is made automatically.

Figure 18 Changing a Menu Item



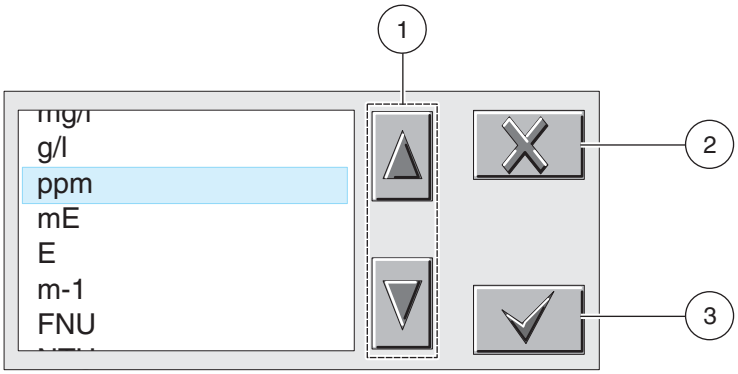
1. Display Area	**42.** **HOME**–changes to the display of measured values.
39. **BACK**	**43.** **UP**–scrolls up
40. **FORWARD**	**44.** **DOWN**–scrolls down
41. **ENTER**–confirms the entry or selection.	

Figure 19 Keypad



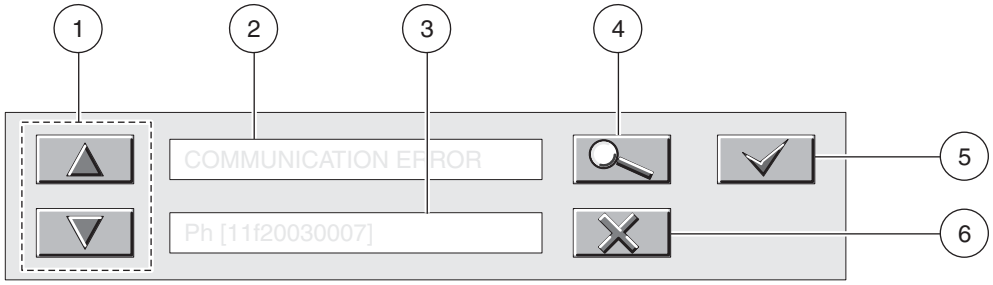
1. Enters numbers or the character as shown on the button.
45. Moves the cursor one position to the left or to the right.
46. Increase/Decrease a number or letter at the cursor position. Keep the button pressed to change the numbers/characters continuously.
47. Deletes the character to the left of the cursor.
48. **CANCEL**–cancels the entry.
49. **ENTER**–confirms the entry or selection.

Figure 20 List Box



1.	Scrolls up or down
50.	**CANCEL**–cancels and entry.
51.	**ENTER**–confirms a selection.

Figure 21 Message window



1.	Scrolls up or down.
52.	Displays the messages or warnings.
53.	Displays details on the selected entry.
54.	This button changes back to the previous display.
55.	**ENTER**–confirms an entry.
56.	**CANCEL**–cancels an entry.

Section 5 Operation

5.1 Sensor Setup

When a sensor is initially installed, the serial number of the sensor will be displayed as the sensor name. To change the sensor name refer to the following instructions:

1. Select Main Menu.
2. From the Main Menu, select SENSOR SETUP and confirm.
3. Highlight the appropriate sensor if more than one sensor is attached and confirm.
4. Select CONFIGURE and confirm.
5. Select EDIT NAME and edit the name. Confirm or cancel to return to the Sensor Setup menu.

5.2 Sensor Data Logging

The sc controller provides one data log and one event log for each sensor. The data log stores the measurement data at selected intervals. The event log stores a variety of events that occur on the devices such as configuration changes, alarms, warning conditions, etc. The data log and the event log can be read out in a CSV format. For downloading the logs please refer to the controller user manual.

5.3 Sensor Diagnostics Menu for pH and ORP Menu

SELECT SENSOR (if more than one sensor is attached)

STATUS	
ERROR LIST	See section 7.1 on page 37.
WARNING LIST	See section 7.2 on page 37.

5.4 pH Sensor Setup Menu

SELECT SENSOR (if more than one sensor is attached)

CALIBRATE	
1-POINT AUTO	Calibration with a single buffer — normally pH 7.
2-POINT AUTO	Calibration with two buffers — normally pH 7 and pH 4 or 10.
1-POINT MANUAL	Calibration against a single known sample.
2-POINT MANUAL	Calibration against two samples, both with a known pH.
TEMP ADJUST	Adjust the displayed temperature by up to ± 15 °C.
DEFAULT SETUP	Restores the system to the original factory calibration.

5.4 pH Sensor Setup Menu (continued)

CONFIGURE	
EDIT NAME	Enter a 10-digit name in any combination of symbols and alpha or numeric characters.
SELECT MEASURE	Select the appropriate measurement units to display.
DISPLAY FORMAT	Select the measurement resolution (xx.xx pH or xx.x pH).
TEMP UNITS	Choose from the displayed options (°C or °F).
LOG SETUP	Choose SENSOR INTERVAL to set the sensor log interval or select TEMP INTERVAL to set the temperature log interval.
REJECT FREQUENCY	Choose 50 or 60 Hz depending on the power line frequency for optimal noise rejection. Default is 60 Hz.
FILTER	Select 0–60 second signal averaging time.
TEMP ELEMENT	Select type of temperature element from the displayed choices.
SELECT BUFFER	Select the buffer type (standard 4, 7, 10 or DIN 19267) from the displayed choices.
PURE H20 COMP	Allows the user to specify that ammonia, morpholine, or other user-defined electrolyte is being used in the application, allowing a temperature-dependent linear slope factor to be applied to the measured pH.
CAL DAYS	Number of days since the last calibration. Default notification at 60 days.
SENSOR DAYS	Number of days the sensor has been in operation. Default notification at 365 days.
DEFAULT SETUP	Resets all user-editable options to their factory-defaults.
DIAG/TEST	
PROBE INFO	Display the sensor type, entered name of the sensor (Default: sensor serial number.), the sensor serial number, the software version number, and the sensor driver version number.
CAL DATA	Displays the pH slope and the date of the last calibration
SIGNAL	SENSOR SIGNAL: Displays the sensor output in mV SENSOR ADC COUNTS: Displays the sensor ADC counts TEMP ADC COUNTS: Displays raw data for temperature ADC counts. ADC counts are comparable to A/D counts and are for sensor electronic diagnostic purposes only. ELECTRODE STATE: Identifies the state of the electrode (good or bad) depending on whether the impedance is within preset limits. ACTIVE ELECT: Displays the impedance (Mohms) of the active electrode if Imped Status is set to Enabled. REF. ELECTRODE: Displays the impedance (Mohms) of the reference electrode if Imped Status is set to Enabled. IMPED STATUS: Sensor diagnostic. Choose Enabled or Disabled.
COUNTERS	SENSOR DAYS: displays the cumulative days the sensor has been in use. RESET SENSOR: Allows the sensor counter to be reset to zero. ELECTRODE DAYS: Cumulative days the electrode has been in use.

5.5 ORP Sensor Setup Menu

SELECT SENSOR (if more than one sensor is attached)

CALIBRATE	
1-POINT MANUAL	Calibration against a single known sample.
TEMP ADJUST	Adjust the displayed temperature by up to ± 15 °C.
DEFAULT SETUP	Restores the system to the original factory calibration.
CONFIGURE	
EDIT NAME	Enter up to a 10-digit name in any combination of symbols and alpha or numeric characters. Press **ENTER** when the entry is complete. The name will be displayed on the status line with the measurement value.
SELECT SENSOR	Choose from the displayed sensor type (pH or ORP).
TEMP UNITS	Choose from the displayed options (°C or °F).
LOG SETUP	Choose SENSOR INTERVAL to set the sensor log interval or select TEMP INTERVAL to set the temperature log interval.
AC FREQUENCY	Choose 50 or 60 Hz depending on the power line frequency for optimal noise rejection. Default is 60 Hz.
FILTER	Select 0–60 second signal averaging time.
TEMP ELEMENT	Select type of temperature element from the displayed choices.
SELECT BUFFER	Select the buffer type (standard 4, 7, 10 or DIN 19267) from the displayed choices.
PURE H20 COMP	Allows the user to specify that ammonia, morpholine, or other user-defined electrolyte is being used in the application, allowing a temperature-dependent linear slope factor to be applied to the measured pH.
CAL DAYS	Number of days since the last calibration. Default notification at 60 days.
SENSOR DAYS	Number of days the sensor has been in operation. Default notification at 365 days.
IMPED LIMITS	Set min/max electrode sensor impedance limits.
DEFAULT SETUP	Resets all user-editable options to their factory-defaults.
DIAG/TEST	
PROBE INFO	Display the sensor type, entered name of the sensor (Default: sensor serial number.), the sensor serial number, the software version number, and the sensor driver version number.
CAL DATA	Displays the pH slope and the date of the last calibration
SIGNAL	SENSOR SIGNAL: displays the sensor output in mV SENSOR ADC COUNTS: displays the sensor ADC counts TEMP ADC COUNTS: shows raw data for temperature ADC counts. ADC counts are comparable to A/D counts and are for sensor electronic diagnostic purposes only. ELECTRODE STATE: Identifies the state of the electrode (good or bad) depending on whether the impedance is within preset limits. ACTIVE ELECT: Shows the impedance (Mohms) of the active electrode if Imped Status is set to Enabled. REF. ELECTRODE: Shows the impedance (Mohms) of the reference electrode if Imped Status is set to Enabled. IMPED STATUS: Sensor diagnostic. Choose Enabled or Disabled.
COUNTERS	SENSOR DAYS: displays the cumulative days the sensor has been in use. RESET SENSOR: allows the sensor counter to be reset to zero. ELECTRODE DAYS: Cumulative days the electrode has been in use.

5.6 pH Calibration

The manufacturer offers one and two point automatic and manual calibrations for pH. An automatic calibration identifies the buffer table corresponding to the chosen buffer and automatically calibrates the probe after it stabilizes. A manual calibration is performed by placing the pH sensor in any buffer or sample with a known value and then entering that known value into the controller.

The value of the sample used in the manual calibration may be determined by laboratory analysis or comparison reading.

1. From the Main Menu, select SENSOR SETUP and confirm.
2. Select the appropriate sensor if more than one is attached and confirm.
3. Select CALIBRATE and confirm.
4. Select 1 POINT AUTO. Select the available Output Mode (Active, Hold, or Transfer) and confirm.
5. Move the clean probe to buffer and confirm to continue.
6. Confirm when stable. A screen will display 1 Point Auto Complete and the slope (XX.X mV/pH).
7. Return the probe to process.

5.6.1 Two Point Automatic Calibration

1. From the Main Menu, select SENSOR SETUP and confirm.
2. Select the appropriate sensor if more than one is attached and confirm.
3. Select CALIBRATE and confirm.
4. Select 2 POINT AUTO. Select the available Output Mode (Active, Hold, or Transfer) and confirm.
5. Move the clean probe to Buffer 1 and confirm.
6. Confirm when stable.
7. Move the clean probe to Buffer 2 and confirm.
8. Confirm when stable. A screen will display 2 Point Calibration Complete and the slope (XX.X mV/pH).
9. Return the probe to process.

5.6.2 One Point Manual Calibration

1. From the Main Menu, select SENSOR SETUP and confirm.
2. Select the appropriate sensor if more than one is attached and confirm.
3. Select CALIBRATE and confirm.

4. Select 1 POINT MANUAL. Select the available Output Mode (Active, Hold, or Transfer) and confirm.

5. Move the clean probe to solution and confirm to continue.

6. Confirm when stable. Edit the solution value and confirm.

7. Confirm when stable. A screen will display 1 Point Manual Complete and the slope (XX.X mV/pH).

8. Return the probe to process.

5.6.3 Two Point Manual Calibration

1. From the Main Menu, select SENSOR SETUP and confirm.

2. Select the appropriate sensor if more than one is attached and confirm.

3. Select CALIBRATE and confirm.

4. Select 2 POINT MANUAL CAL. Select the available Output Mode (Active, Hold, or Transfer) and confirm.

5. Move the clean probe to Solution 1 and confirm.

6. Confirm when stable. Edit the solution value and confirm.

7. Move probe to solution 1 and confirm.

8. Confirm when stable. Edit the solution value and confirm.

9. A screen will display 2 Point Manual Cal Complete and the slope (XX.X mV/pH).

10. Return the probe to process.

5.7 ORP Calibration

The manufacturer offers a one point manual calibration for ORP. The value of the sample used in the manual calibration may be determined by laboratory analysis or comparison reading.

1. From the Main Menu, select SENSOR SETUP and confirm.

2. Select the appropriate sensor if more than one is attached and confirm.

3. Select CALIBRATE and confirm.

4. Select 1 POINT MANUAL CAL. Select the available Output Mode (Active, Hold, or Transfer) and confirm.

5. Move the clean probe to Solution and confirm.

6. Confirm when stable. Edit the solution value and confirm.

7. A screen will display 1 Point Manual Complete and the slope (XX.X mV).

8. Return the probe to process.

5.8 Concurrent Calibration of Two Sensors for pH and ORP

1. Begin a calibration on the first sensor and continue until “Wait to Stabilize” is displayed.
2. Select LEAVE and confirm. The display will return to the main measurement screen. The reading for the sensor currently being calibrated will flash.
3. Begin the calibration for the second sensor and continue until “Wait to Stabilize” is displayed.
4. Select LEAVE and confirm. The display will return to the main measurement screen and the reading for both sensors will flash. The calibration for both sensors are now running in the background.
5. To return to the calibration of either sensor select SENSOR SETUP from the Main Menu and confirm. Select the appropriate sensor and confirm.
6. The calibration in progress will be displayed. Continue with the calibration.

5.9 Adjusting the Temperature

View or change the temperature using the steps below.

1. From the Main Menu, select SENSOR SETUP and confirm.
2. Select the appropriate sensor if more than one is attached and confirm.
3. Select CALIBRATE and confirm.
4. Select TEMP ADJUST and confirm.
5. Select MEASURED TEMP and confirm.
6. The temperature will be displayed. Edit the temperature and confirm.

DANGER
Only qualified personnel should conduct the tasks described in this section of the manual.

DANGER
Seul un technicien qualifié peut effectuer les tâches d'installation décrites dans cette section du manuel.

DANGER
Explosion hazard. Do not connect or disconnect equipment unless power has been switched off or the area is known to be non-hazardous.

DANGER
Risque d'explosion. Couper le courant ou s'assurer que l'emplacement est designe non dangereux avant de replacer le aucon composant.

DANGER
Explosion hazard. Substitution of components may impair suitability for Class 1, Division 2.

DANGER
Risque d'explosion. La substitution de composants peut rendre ce materiel inacceptable pour les emplacements de Classe 1, Division 2..

6.1 Maintenance Schedule

Maintenance Task	90 days	Annually
Clean the sensor[1]	x	
Inspect sensor for damage	x	
Replace Salt Bridge and fill solution[2]		x
Calibrate Sensor (as required by regulatory agency)	**Per the schedule mandated by your regulatory agency.**	

[1] Cleaning frequency is application dependent. More or less frequent cleaning will be appropriate in some applications.
[2] Salt bridge replacement frequency is application dependent. More or less frequent replacement will be appropriate in some applications

6.2 Cleaning the Sensor

CAUTION
Before cleaning with acid, determine if the chemical reaction between the acid and the sample will create a hazardous chemical reaction. (For example, do not put a sensor that is used in a cyanide bath directly into a strong acid for cleaning because this chemical combination may produce poisonous cyanide gas.)

1. Clean the exterior of the sensor with a stream of water. If debris remains remove loose contaminate buildup by carefully wiping the entire measuring end of the sensor (process electrode, concentric metal ground electrode, and salt bridge) with a soft clean cloth. Rinse the sensor with clean, warm water.

2. Prepare a mild soap solution of warm water and dish detergent or other non-abrasive soap that does not contain lanolin such as laboratory glass cleaner.

Note: *Lanolin will coat the glass process electrode and can adversely affect sensor performance.*

3. Soak the sensor for 2 to 3 minutes in the soap solution.

4. Use a small soft bristle brush (such as a toothbrush) and scrub the entire measuring end of the sensor, thoroughly cleaning the electrode and salt bridge surfaces. If surface deposits cannot be removed by detergent solution cleaning, use muriatic acid (or other dilute acid) to dissolve them. The acid should be as dilute as possible. Experience will determine which acid to use and the appropriate dilution ratio. Some stubborn coatings may require a different cleaning agent. For assistance, contact Technical and Customer Service (U.S.A. only) on page 43.

DANGER
Acids are hazardous. Always wear appropriate eye protection and clothing in accordance with material safety data sheet recommendations.

5. Soak the entire measuring end of the sensor in dilute acid for no more than 5 minutes. Rinse the sensor with clean, warm water then place the sensor back into the mild soap solution for 2 to 3 minutes to neutralize any remaining acid.

6. Remove the sensor from the soap solution, and rinse the sensor again in clean, warm water.

7. After cleaning, always calibrate the measurement system.

6.2.1 Replacing the Standard Cell Solution and Salt Bridge

If calibration cannot be attained, rejuvenate the sensor by replacing its standard cell solution and salt bridge as shown in Figure 22. If calibration is still not possible, refer to Section 7 on page 37.

1. To remove the salt bridge, hold the sensor upright (electrode at top), and use pliers or a similar tool to turn it counterclockwise. Take care not to damage the protruding process electrode. Properly discard the old salt bridge.

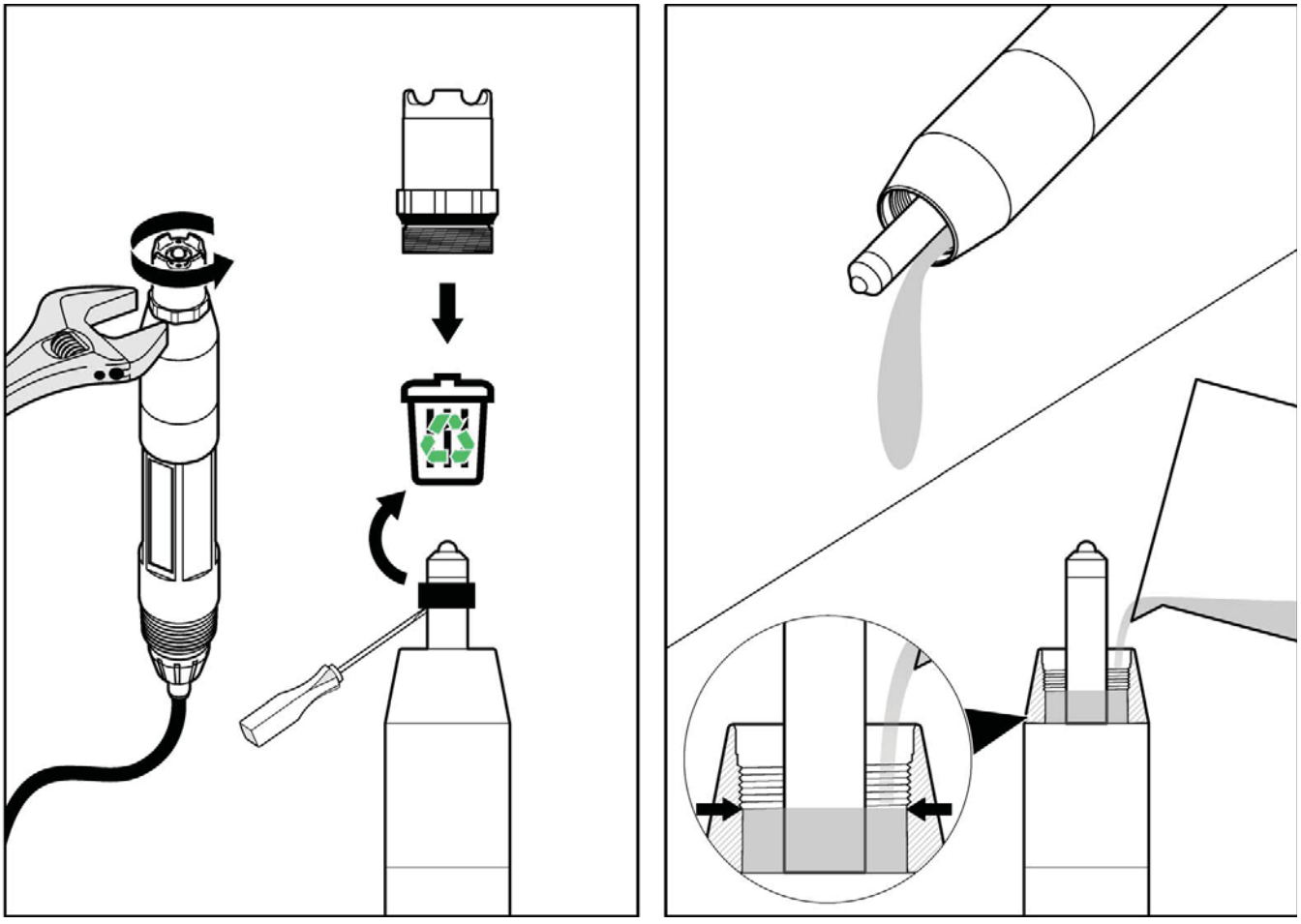
2. Replace the standard cell solution in the sensor reservoir.

   a. Pour out the aged solution, and thoroughly flush the reservoir with standard cell solution.

   b. Fill the reservoir to the bottom of the salt bridge mating threads with fresh standard cell solution (Cat. No. 25M1A1025-115).

3. Carefully thread the new salt bridge clockwise until it is finger-tight and the bottom surface of the salt bridge is in full contact with the top surface of the sensor body. Tighten the salt bridge another ½ turn with the wrench or tool.

Figure 22 Replacing Standard Cell Solution and Salt Bridge



Section 7 Troubleshooting

7.1 Error Codes

When a sensor is experiencing an error condition, the sensor reading on the measurement screen will flash and all relays and analog outputs associated with the sensor will be held. The following conditions will cause the sensor reading to flash:

- Sensor calibration
- Relay timer washing cycle
- Loss of communication

Highlight the Sensor Diag menu and press **ENTER**. Highlight Errors and press **ENTER** to determine the cause of the error.

Errors are defined in Table 6.

Table 6 Error Codes

Displayed Error	Definition	Resolution
ADC FAILURE	System measurement fails	Contact Technical Consulting Services.

7.2 Warnings

A sensor warning will leave all menus, relays, and outputs functioning normally, but will cause a warning icon to flash on the right side of the display. Highlight the Sensor Diag menu and press **ENTER** to determine the cause of the warning.

A warning may be used to trigger a relay and users can set warning levels to define the severity of the warning. Errors are defined in Table 7.

Table 7 Warning Codes

Displayed Warning	Definition	Resolution
PROBE OUT RANGE	Measured pH/ORP exceeds the expected value range.	Contact Technical Consulting Services.
TEMP OUT RANGE	Measured temperature exceeds the expected value range.	Contact Technical Consulting Services.
FLASH FAILURE	System flash memory write has failed.	Contact Technical Consulting Services.
ACTIVE. ELEC	Standard electrode is not performing within the required specifications.	Contact Technical Consulting Services.
REF. ELECTRODE	Reference electrode is not performing within the required specifications.	Contact Technical Consulting Services.
CAL REQUIRED	60 days has elapsed since the last calibration	Perform a calibration.
REPLACE SENSOR	One year has elapsed since the sensor has been installed.	Clean the sensor and replace the salt bridge and standard cell solution (see section 6.2 on page 34 and section 6.2.1 on page 35). Reset the counter in the SENSOR SETUP>CONFIGURE> SENSOR DAYS menu. If necessary, replace the sensor.

7.3 Troubleshooting the pH Sensor

Clean the sensor using the procedure described in section 6.2 on page 34. If the measuring system cannot be calibrated after cleaning, replace the standard cell solution and salt bridge (see section 6.2.1 on page 35) and try calibrating again. If the measuring system still cannot be calibrated, check the sensor operation.

Some simple tests using the sc100 or a multimeter and two pH buffers will determine if the pH sensor is operating properly. The use of pH 7 and pH 4 buffers is preferred but pH 10 can be used in place of pH 4 if it more closely covers the measurement range of interest.

Determine if the sensor has integral digital electronics or uses an external digital gateway. If the sensor uses a digital gateway, it will be hard-wired to the gateway through terminal connections inside the digital gateway enclosure. If the sensor uses the digital gateway and therefore does not have integral digital electronics, proceed with section 7.3.1. If the sensor has integral digital electronics, move to section 7.3.2 on page 39.

7.3.1 Troubleshooting a pH Sensor without Integral Digital Electronics

1. Disconnect the red, green, yellow, and black sensor wires from the digital gateway.

2. Place the sensor in a pH 7 buffer. Before continuing, allow the temperatures of the sensor and buffer to equalize to approximately 25 °C (70 °F).

3. Verify that the sensor temperature element (300 ohm thermistor) is operating properly by measuring the resistance between the yellow and black wires. The reading should be between 250 and 350 ohms at approximately 25 °C (70 °F).

4. Reconnect the yellow and black wires.

5. Connect the multimeter (+) lead to the red wire and (–) lead to the green wire. With the sensor in the pH 7 buffer, measure the dc millivolts. The sensor offset reading should be within the factory-specified limits of –50 and +50 mV. If it is, record the millivolt value reading and continue with step 6. If the reading is outside these limits, discontinue this test and contact Technical Support.

6. With the multimeter still connected, rinse the sensor with water and place it in either pH 4 or pH 10 buffer. Allow the temperatures of the sensor and buffer to equalize to approximately 25 °C (70 °F) then measure the sensor span reading as shown in Table 8 and Table 9 on page 39.

Span Reading in pH 4 Buffer
With the sensor in pH 4 buffer, the sensor span reading should be at least +160 mV more than the offset reading taken in step 5.

Table 8 Typical Span Reading Examples (pH 4 buffer)

Offset Reading (in pH 7 buffer)	Span Reading (in pH 4 buffer)
–50 mV	+110 mV
–25 mV	+135 mV
0 mV	+160 mV
+25 mV	+185 mV
+50 mV	+210 mV

Span Reading in pH 10 Buffer
With the sensor in pH 10 buffer, the sensor span reading should be at least –160 mV less than the noted offset reading taken in step 5.

Table 9 Typical Span Reading Examples (pH 10 buffer)

Offset Reading (in pH 7 buffer)	Span Reading (in pH 10 buffer)
–50 mV	–210 mV
–25 mV	–185 mV
0 mV	–160 mV
+25 mV	–135 mV
+50 mV	–110 mV

If the span reading is at least +160 mV more than or –160 mV less than the offset reading in pH 4 or pH 10, respectively, the sensor is within factory-specified limits. If not, contact Technical Support.

7.3.2 Troubleshooting the pH Sensor with Integral Digital Electronics

1. Place the sensor in pH 7 buffer and allow the buffer and sensor to reach temperature equilibrium. This can be verified by monitoring the sensor temperature value for a stable temperature measurement. This value is shown on the sc100 display when it is in measurement mode.

2. From the Sensor Setup Menu on the sc100, highlight “Diag/Test” and press **ENTER**.

3. Highlight “Sensor Signal” and press **ENTER**. This sensor offset reading should be within factory-specified limits of –50 and +50 mV. If it is, write down this millivolt value reading and perform step 4. If the reading is outside these limits, discontinue this test and contact Technical Support.

4. Rinse the sensor and place it in pH 4 or 10 buffer and allow the buffer and sensor to reach temperature equilibrium. This can be verified by monitoring the sensor temperature value for a stable temperature measurement. This value is located on the sc100 display when it is in measurement mode.

5. From the Sensor Setup Menu on the sc100, highlight “Diag/Test” and press **ENTER**.

6. Highlight “Sensor Signal” and press **ENTER**. Then measure the sensor span value.

Span Reading in pH 4 Buffer
With the sensor in pH 4 buffer, the sensor span reading should be at least +160 mV more than the offset reading as shown in Table 10 and Table 11.

Table 10 Typical Span Reading Examples (pH 4 buffer)

Offset Reading (in pH 7 buffer)	Span Reading (in pH 4 buffer)
–50 mV	+110 mV
–25 mV	+135 mV
0 mV	+160 mV
+25 mV	+185 mV
+50 mV	+210 mV

Span Reading in pH 10 Buffer
With the sensor in pH 10 buffer, the sensor span reading should be at least –160 mV less than the noted offset reading taken in step 6. Examples of typical readings:

Table 11 Typical Span Reading Examples (pH 10 buffer)

Offset Reading (in pH 7 buffer)	Span Reading (in pH 10 buffer)
–50 mV	–210 mV
–25 mV	–185 mV
0 mV	–160 mV
+25 mV	–135 mV
+50 mV	–110 mV

7. If the span reading is at least +160 mV more than or –160 mV less than the offset reading in pH 4 or pH 10, respectively, the sensor is within factory-specified limits. If not, contact Technical Support.

7.4 Checking ORP Sensor Operation

Simple tests using the sc100 or a multimeter and a 200 mV reference solution can determine if the ORP sensor is operating properly. Determine if the sensor has integral digital electronics or uses an external digital gateway. If the sensor uses a digital gateway, it will be hard-wired to the digital gateway through terminal connections within the digital gateway enclosure. If the sensor uses a digital gateway proceed with section 7.4.1. If the sensor has integral digital electronics, move to section 7.4.2 on page 40.

7.4.1 Troubleshooting the ORP Sensor without Integral Digital Electronics

1. Disconnect the red, green, yellow, and black sensor wires from the digital gateway.

2. Place the sensor in a 200 mV reference solution and allow the temperature of the sensor and reference solution to equalize to approximately 25 °C (70 °F).

3. Verify that the sensor temperature element (300 ohm thermistor) is operating by measuring the resistance between the yellow and black wires. The reading should be between 250 and 350 ohms at approximately 25 °C (70 °F).

4. Reconnect the yellow and black wires.

5. Connect the multimeter (+) lead to the red wire and (–) lead to the green wire. With the sensor in the 200 mV reference solution, measure the dc millivolts. The reading should be between 160 and 240 mV. If the reading is outside these limits, contact Technical Support.

7.4.2 Troubleshooting the ORP Sensor with Integral Digital Electronics

1. Place the sensor in 200 mV reference solution and allow the buffer and sensor to reach temperature equilibrium. This can be verified by monitoring the sensor temperature value for a stable temperature measurement. This value is located on the sc100 display when it is in measurement mode.

2. From the Sensor Setup Menu on the sc100, highlight “Diag/Test” and press **ENTER**. Highlight “Sensor Signal” and press **ENTER**. The reading should be between 160 and 240 mV. If the reading is outside these limits, contact Customer Service.

Section 8 Replacement Parts and Accessories

8.1 Replacement Items, Accessories, and Reagent and Standards

Item Description	QTY	Catalog Number
Air blast cleaning system, 115 V, includes Kynar® (PVDF) washer head with 7.6 m (25 ft) tubing and quick connect fitting, and a compressor in a NEMA 4X enclosure	each	1000A3335-005
Air blast cleaning system, 230 V, includes Kynar® (PVDF) washer head with 7.6 m (25 ft) tubing and quick connect fitting, and a compressor in a NEMA 4X enclosure	each	1000A3335-006
Air/Water blast cleaning head	each	1000A3335-004
Buffer, pH 7	500 mL (1 pint)	2283549
Buffer, pH 4	500 mL (1 pint)	2283449
Buffer, pH 10	500 mL (1 pint)	2283649
Buffer, pH 7	1 gallon	2283556
Buffer, pH 4	1 gallon	2283456
Buffer, pH 10	1 gallon	2283656
Buffer, pH 7	500 mL (1 pint)	2283549
Cable, interconnect, unterminated ends, specify length in whole feet	each	1W1100
Cable, sensor extension, 1 m (3 ft)	each	6122400
Cable, sensor extension, 7.7 m (25 ft)	each	5796000
Cable, sensor extension, 15 m (50 ft)	each	5796100
Cable, sensor extension, 31 m (100 ft)	each	5796200
Connector Cable	each	6139900
Instruction manual, Differential pH System, English	each	6120218
Plug, sealing, conduit opening	each	5868700
O-ring, Viton	each	5H1304
O-ring, EPDM	each	5H1306
O-ring, Perflouro	each	5H1096-019
ORP Standard Solution, 200 mV	500 mL (1 pint)	25M2A1001-115
ORP Standard Solution, 600 mV	500 mL (1 pint)	25M2A1002-115
ORP Standard Solution, 200 mV	1 gallon	25M2A1001-123
ORP Standard Solution, 600 mV	1 gallon	25M2A1002-123
Salt Bridge, PEEK® Body, PVDF outer junction	each	SB-P1SV
Salt Bridge Ryton® Body, PVDF outer junction	each	SB-R1SV
Standard Cell Solution	each	25M1A1025-115
Strain relief, Heyco	each	16664

Section 9 How to Order

U.S.A. Customers

By Telephone:
6:30 a.m. to 5:00 p.m. MST
Monday through Friday
(800) 227-HACH (800-227-4224)

By Fax:
(970) 669-2932

By Mail:
Hach Company
P.O. Box 389
Loveland, Colorado 80539-0389 U.S.A.
Ordering information by e-mail: orders@hach.com

Information Required

- Hach account number (if available)
- Your name and phone number
- Purchase order number
- Brief description or model number
- Billing address
- Shipping address
- Catalog number
- Quantity

International Customers

Hach maintains a worldwide network of dealers and distributors. To locate the representative nearest you, send an e-mail to: intl@hach.com or contact:

Hach Company World Headquarters; Loveland, Colorado, U.S.A.
Telephone: (970) 669-3050; Fax: (970) 669-2932

Technical and Customer Service (U.S.A. only)

Hach Technical and Customer Service Department personnel are eager to answer questions about our products and their use. Specialists in analytical methods, they are happy to put their talents to work for you.

Call 1-800-227-4224 or e-mail techhelp@hach.com

Section 10 Repair Service

Authorization must be obtained from Hach Company before sending any items for repair. Please contact the Hach Service Center serving your location.

In the United States:
Hach Company
Ames Service
100 Dayton Avenue
Ames, Iowa 50010
(800) 227-4224 (U.S.A. only)
FAX: (515) 232-3835

In Canada:
Hach Sales & Service Canada Ltd.
1313 Border Street, Unit 34
Winnipeg, Manitoba
R3H 0X4
(800) 665-7635 (Canada only)
Telephone: (204) 632-5598
FAX: (204) 694-5134
E-mail: canada@hach.com

**In Latin America, the Caribbean, the Far East,
Indian Subcontinent, Africa, Europe, or the Middle East:**
Hach Company World Headquarters,
P.O. Box 389
Loveland, Colorado, 80539-0389 U.S.A.
Telephone: (970) 669-3050
FAX: (970) 669-2932
E-mail: intl@hach.com

Section 11 Limited Warranty

Hach Company warrants its products to the original purchaser against any defects that are due to faulty material or workmanship for a period of one year from date of shipment unless otherwise noted in the product manual.

In the event that a defect is discovered during the warranty period, Hach Company agrees that, at its option, it will repair or replace the defective product or refund the purchase price excluding original shipping and handling charges. Any product repaired or replaced under this warranty will be warranted only for the remainder of the original product warranty period.

This warranty does not apply to consumable products such as chemical reagents; or consumable components of a product, such as, but not limited to, lamps and tubing.

Contact Hach Company or your distributor to initiate warranty support. Products may not be returned without authorization from Hach Company.

Limitations

This warranty does not cover:

- Damage caused by acts of God, natural disaster, labor unrest, acts of war (declared or undeclared), terrorism, civil strife or acts of any governmental jurisdiction
- Damage caused by misuse, neglect, accident or improper application or installation
- Damage caused by any repair or attempted repair not authorized by Hach Company
- Any product not used in accordance with the instructions furnished by Hach Company
- Freight charges to return merchandise to Hach Company
- Freight charges on expedited or express shipment of warranted parts or product
- Travel fees associated with on-site warranty repair

This warranty contains the sole express warranty made by Hach Company in connection with its products. All implied warranties, including without limitation, the warranties of merchantability and fitness for a particular purpose, are expressly disclaimed.

Some states within the United States do not allow the disclaimer of implied warranties and if this is true in your state the above limitation may not apply to you. This warranty gives you specific rights, and you may also have other rights that vary from state to state.

This warranty constitutes the final, complete, and exclusive statement of warranty terms and no person is authorized to make any other warranties or representations on behalf of Hach Company.

Limitation of Remedies

The remedies of repair, replacement or refund of purchase price as stated above are the exclusive remedies for the breach of this warranty. On the basis of strict liability or under any other legal theory, in no event shall Hach Company be liable for any incidental or consequential damages of any kind for breach of warranty or negligence.

Section 12 Compliance Information

Hach Co. certifies this instrument was tested thoroughly, inspected and found to meet its published specifications when it was shipped from the factory.

The Model sc100/sc1000 Controller with Differential pH/ORP sensor has been tested and is certified as indicated to the following instrumentation standards:

Product Safety

UL 61010A-1 (ETL Listing # 65454)
CSA C22.2 No. 1010.1 (ETLc Certification # 65454)
Certified by Hach Co. to EN 61010-1 Amds. 1 & 2 (IEC1010-1) per 73/23/EEC, supporting test records by Intertek Testing Services.

Immunity

This equipment was tested for industrial level EMC per:

EN 61326 (EMC Requirements for Electrical Equipment for Measurement, Control and Laboratory Use) **per 89/336/EEC EMC:** Supporting test records by Hach Company, certified compliance by Hach Company.

Standards include:

IEC 1000-4-2:1995 (EN 61000-4-2:1995) Electrostatic Discharge Immunity (Criteria B)
IEC 1000-4-3:1995 (EN 61000-4-3:1996) Radiated RF Electromagnetic Field Immunity (Criteria A)
IEC 1000-4-4:1995 (EN 61000-4-4:1995) Electrical Fast Transients/Burst (Criteria B)
IEC 1000-4-5:1995 (EN 61000-4-5:1995) Surge (Criteria B)
IEC 1000-4-6:1996 (EN 61000-4-6:1996) Conducted Disturbances Induced by RF Fields (Criteria A)
IEC 1000-4-11:1994 (EN 61000-4-11:1994) Voltage Dip/Short Interruptions (Criteria B)

Additional Immunity Standard/s include:

ENV 50204:1996 Radiated Electromagnetic Field from Digital Telephones (Criteria A)

Emissions

This equipment was tested for Radio Frequency Emissions as follows:

Per **89/336/EEC** EMC: **EN 61326:1998** (Electrical Equipment for measurement, control and laboratory use—EMC requirements) Class “A” emission limits. Supporting test records by Hewlett Packard, Fort Collins, Colorado Hardware Test Center (A2LA # 0905-01) and certified compliance by Hach Company.

Standards include:

EN 61000-3-2 Harmonic Disturbances Caused by Electrical Equipment
EN 61000-3-3 Voltage Fluctuation (Flicker) Disturbances Caused by Electrical Equipment

Additional Emissions Standard/s include:

EN 55011 (CISPR 11), Class “A” emission limits

Canadian Interference-causing Equipment Regulation, IECS-003, Class A

Supporting test records by Hewlett Packard, Fort Collins, Colorado Hardware Test Center (A2LA # 0905-01) and certified compliance by Hach Company.

This Class A digital apparatus meets all requirements of the Canadian Interference-causing Equipment Regulations.
Cet appareil numèrique de la classe A respecte toutes les exigences du Rëglement sur le matÈriel brouilleur du Canada.

FCC PART 15, Class “A” Limits

Supporting test records by Hewlett Packard, Fort Collins, Colorado Hardware Test Center (A2LA # 0905-01) and certified compliance by Hach Company.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

(1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications to this unit not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his own expense. The following techniques of reducing the interference problems are applied easily.

1. Disconnect the Controller from its power source to verify that it is or is not the source of the interference.

2. If the Controller is connected into the same outlet as the device with which it is interfering, try another outlet.

3. Move the Controller away from the device receiving the interference.

4. Reposition the receiving antenna for the device receiving the interference.

5. Try combinations of the above.

Appendix A General pH Information

A.1 pH Measurement Theory

pH is the negative logarithm of the hydrogen ion activity and a measure of the acidity or alkalinity of a solution.

$$pH = -\log A[H+]$$

pH is normally measured using a glass electrode and a reference electrode.

The glass electrode acts as a transducer, converting chemical energy (the hydrogen ion activity) into an electrical energy (measured in millivolts). The reaction is balanced and the electrical circuit is completed by the flow of ions from the reference solution to the solution under test.

The electrode and reference solution together develop a voltage (emf) whose magnitude depends on the type of reference electrode, the internal construction of the glass electrode, the pH of the solution and the temperature of the solution. This voltage is expressed by the Nernst Equation:

$$E = E_o - (2.3\ RT/F) \times \log A[H+]$$
$$E = E_o - (\text{slope}) \times \log A[H+]$$

where:

E = the emf of the cell

E_o = the zero potential (isopotential) of the system. It depends on the internal construction of the glass and reference electrodes.

R = gas constant

T = temperature in Kelvin

A[H+] = activity of the hydrogen ion (assumed to be equivalent to the concentration of hydrogen ions)

F = Faraday constant

For every unit change in pH (or decade change in ion concentration) the emf of the electrode pair changes by 59.16 mV at 25 °C. This value is known as the Nernstian Slope of the electrode.

The pH electrode pair is calibrated using solutions of known and constant hydrogen ion concentration, called buffer solutions. The buffer solutions are used to calibrate both the electrode isopotential and slope.

A.2 PID Controller Basics

A pH control loop operates as follows: The pH meter measures the value of the pH in the effluent, and, if the pH is different from the setpoint, the controller actuates the reagent pump (or valve) that adds reagent to a mixing tank. The added reagent adjusts the pH value of the process.

The physical layout of the loop, the sizing of the pump (valve), type of mixing tank, and location of the pH electrodes all have a major impact on the ultimate performance of the loop, after the controller is tuned for optimal performance. The largest single performance factor is the delay time around the loop. This includes the response time of the

electrode/meter, time required to deliver the reagent to the process water, time required for the reagent to mix with and react with the process water, and the time required to deliver the completely mixed water to the electrode. If the delay times are too long or the mixing is not complete, the control will be poor regardless of how well the controller is tuned.

The Process pH Meter uses a PID (proportional, integral (reset), derivative (rate) control) control algorithm. Each of the instrument settings along with their effects on the control loop, are described below.

Mode
Manual: The manual output is specified in percent of full-scale PID output (4–20 mA) and is commonly used for testing the output device.

Auto: Allows the process to be controlled automatically using information specified in the Phase, Setpoint, Proportional Band, Integral, and Derivative menus as follows:

Phase
Direct: The control output action will cause the process value to increase.

Reverse: The control output action will cause the process value to decrease.

Setpoint
The setpoint is defined as the desired process value in pH

Proportional Band
The proportional band is the range in pH from the setpoint value where the controller provides proportional control. For example, the desired setpoint for the process is pH 7.0 and the process requires that a reagent must be added to the process water to bring it up to pH 7.0. If the proportional band is set to pH 1.0, the controller will provide proportional output control over the range of pH 6.0 to 8.0. When the process is at pH 6.0, the controller will provide a 100% control output level (assuming that Phase is set to Direct). When the process is at pH 7.0, the proportional control will provide a 0% control output level. When the process is at pH 6.5 the proportional control will provide a 50% output. The output action is equal to the difference between the setpoint and the process value, divided by the proportional band value.

Integral
The integral value is used to reduce the steady state error, between the process value and the setpoint, to zero. For example, assume a process can be manually controlled at a level of pH 8.0 by sending a 35% control output level to a reagent pump. Now, say that the system is set up for the controller to provide proportional only control, with the controller setpoint set to pH 8.0 and the proportional band set to pH 1.0. Note that the nearer the process gets to the pH 8.0 setpoint, the lower the control output level is. In fact, when the process is at pH 8.0, the output level will be 0%. Since the process requires that the pump be operated at 35% for the process to reach pH 8.0, its apparent that proportional-only control will never quite reach the desired setpoint of pH 8.0. This is where the integral control comes in.

Integral control can be thought of as adding up the output action from the proportional control over time. For example, the proportional control output reaches a steady state level of 5%. If the integral time is set to five minutes, the integral action of the controller will add an additional 5% to the controller output level over a 5-minute interval. The integral action is additive, so for every 5-minute interval an additional 5% is added to the controller's output level. This will allow the controller to bring the process to the desired setpoint level. Note that the longer the integral time setting, the longer it takes for the

integral action to affect the process. The integral control action is disabled by setting it to zero. Note that the integral time is in minutes.

Derivative
Derivative control is used to adjust the control output level based upon the rate at which the process value is approaching or passing the setpoint. Derivative control action would be used in cases where the process value can rapidly ramp up and overshoot the setpoint. The derivative setting is in minutes. The output action of the derivative control is equal to the rate of change of the process (in pH units per minute) times the derivative time, divided by the proportional band, times negative one. For example, if the process pH is changing at a rate of pH 0.20 per minute, the derivative time is set to 3.0 minutes, the proportional band is set to pH 0.80, and the action is “direct” the derivative control output action will be approximately equal to: (–0.20 pH/minute X 3.0 minute) /0.80 pH = –75%.

During calibration, the analog outputs can remain active, be held, or be transferred to a preset mA value.

Appendix B Modbus Register Information

Table 12 Sensor Modbus Registers

Group Name	Tag Name	Register #	Data Type	Length	R/W	Description
Tags	SensorMeasTag	40001	Integer	1	R	Sensor measurement tag
Measurements	pHMeas	40002	Float	2	R	pH /ORP measurement
Tags	TempMeasTag	40004	Integer	1	R	Temperature measurement tag
Measurements	TempDegCMeas	40005	Float	2	R	Temperature measurement
Configuration	SensorName	40007	String	6	R/W	Sensor name
Tags	FuncCode	40013	Integer	1	R/W	Function code tag
Tags	NextState	40014	Integer	1	R/W	Next state tag
Configuration	MeasType	40015	Integer	1	R/W	Measurement type-pH or ORP
Configuration	TempUnits	40016	Integer	1	R/W	Temperature units-C or F
Configuration	pHFormat	40017	Integer	1	R/W	pH display format
Configuration	TaggedPhFormat	40018	Long	2	R	pH display tagged format
Configuration	Filter	40020	Integer	1	R/W	Sensor filter
Configuration	TempElementType	40021	Integer	1	R/W	Temperature element type
Tags	TempUserValueTag	40022	Integer	1	R	Temperature user value tag
Configuration	TempUserDegCValue	40023	Float	2	R/W	Temperature user value
Configuration	pHBuffer	40025	Integer	1	R/W	pH buffer type
Configuration	PureWaterCompType	40026	Integer	1	R/W	Pure H_2O compensation type
Configuration	PureWaterCompUser	40027	Float	2	R/W	Pure H_2O compensation user val
Calibration	OutputMode	40029	Integer	1	R/W	Output mode
Calibration	CalLeave	40030	Integer	1	R/W	Cal leave mode
Calibration	CalAbort	40031	Integer	1	R/W	Cal abort mode
Tags	CalEditValueTag	40032	Integer	1	R	Cal edit value tag
Calibration	CalEditPhValue	40033	Float	2	R/W	Cal edit value
Diagnostics	pHSlope	40035	Float	2	R	pH slope
Diagnostics	SoftwareVersion	40037	String	6	R	Software version
Diagnostics	SerialNumber	40043	String	6	R	Serial number
Diagnostics	pHOffset	40049	Float	2	R	pH offset
Diagnostics	OrpOffset	40051	Float	2	R	Orp offset
Calibration	CalCode	40053	Integer	1	R	Cal code
Configuration	SensorLogInterval	40054	Integer	1	R/W	Sensor data log interval
Configuration	TempLogInterval	40055	Integer	1	R/W	Temperature data log interval
Diagnostics	pHmV	40056	Float	2	R	pH mV
Diagnostics	ProdDate	40058	Date	2	R/W	Production date
Diagnostics	StdElectrode	40060	Float	2	R	Standard electrode impedance
Diagnostics	RefElectrode	40062	Float	2	R	Reference electrode impedance
Diagnostics	LastCalDate	40064	Date	2	R	Last calibration date
Diagnostics	SensorDays	40066	Integer	1	R	Sensor running days
Diagnostics	ElectrodeDays	40067	Integer	1	R	Electrode running days
Diagnostics	ElectrodeStatus	40068	Integer	1	R	Electrode status
Diagnostics	SensorType	40069	Integer	1	R	Sensor type
Configuration	RejectFrequency	40070	Integer	1	R/W	Reject frequency
Diagnostics	DeviceDriver	40071	String	5	R	Device driver
Configuration	CalWarningDays	40076	Integer	1	R/W	Calibration warning days
Configuration	SensorWarningDays	40077	Integer	1	R/W	Sensor warning days

Index

MANUFACTURER INSTALLATION OPERATION AND MAINTENANCE MANUAL

AMARUQ WTP – NUNAVUT

VEOLIA PROJECT: 5000 218 009

HAPMAN

VACUUM CONVEYOR SYSTEM

LEFT BLANK

HAPMAN
Ideas that move.
Gen
a MGlobal company

VEOLIA WATER TECHNOLOGIES CANADA INC.

JOB# H17116

PO# 18000905 HD 05000

Installation, Operation and Maintenance Manual

Performantee
Designed for results – guaranteed.

Global Headquarters
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www.hapman.com

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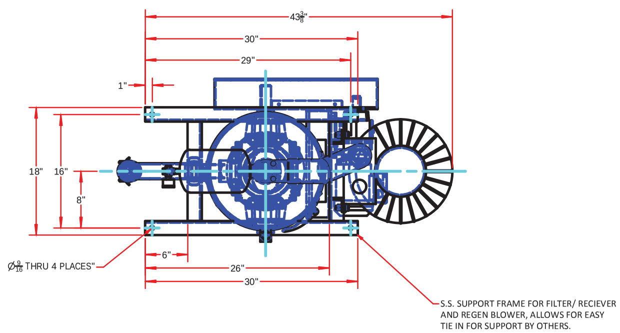
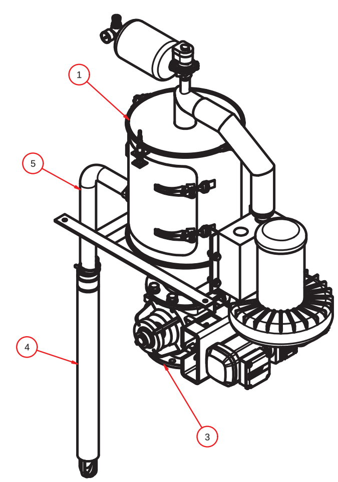
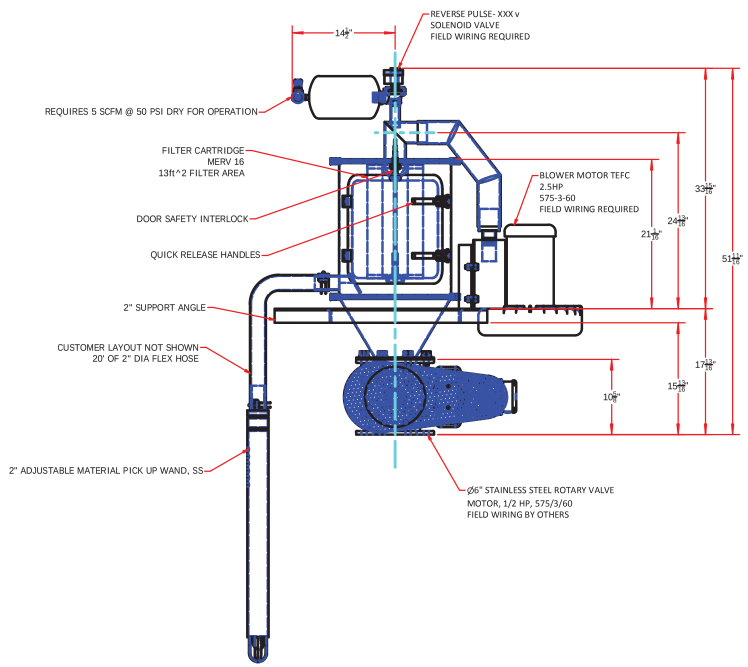
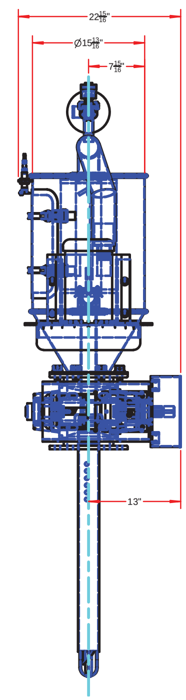
LTR	REVISION DESCRIPTION	DATE	BY
A	REMOVED 2" COLLAR ON CONE	5/17/18	JLB



NOTES:
(1) PURCHASE ORDER NUMBER: 18000905 HD 05000
(2) MATERIAL CONVEYED: POTASSIUM PERMANGANATE
PARTICLE SIZE: POWDER
BULK DENSITY: 94 LBS/ CU FT
MOISTURE CONTENT: DRY
TEMPERATURE: AMBIENT
FLOWABILITY: FREE
ABRASIVENESS: MILDLY
MATERIAL CHARACTERISTICS: X
CAPACITY REQUIREMENTS: 77 Kgs/DAY
(3) MATERIAL CONTACT SURFACES: STAINLESS STEEL
(4) HAPMAN STANDARD GRADE FINISH SPECIFICATION #40-108, REV "C"
(5) SUPPORT AND INSTALLATION LABOR FURNISHED BY OTHER.
(6) MOTOR 575v/3PH/60HZ







CONTROLS, FILTER PULSE TIMER & MOTOR STARTER BY OTHERS

APPROVAL DRAWING

☐ APPROVED WITH NO CHANGES
☐ APPROVED AS NOTED
☐ RESUBMIT WITH CHANGES NOTED

BY ____________ DATE ________

TITLE ____________

THE EQUIPMENT SHOWN ON THIS DRAWING WILL BE RELEASED FOR FABRICATION UPON RECEIPT OF THIS SIGNED APPROVAL DRAWING AT HAPMAN. PLEASE VERIFY THE ACCURACY OF THE DIMENSIONAL AND APPLICATION INFORMATION PRIOR TO SIGNING. CHANGES TO THE DESIGN AFTER APPROVAL WILL RESULT IN SCHEDULE DELAYS AND REQUIRE A PURCHASE ORDER PRICE CHANGE.

REV.	SUF.	ITEM NO.	DRAWING / PART NO.	DESCRIPTION	ITEM QTY
	AA	1	H17116AA-D00	16" FILTER/RECEIVER HOUSING, SS	1
	AB	3	H17116AB-L00	6" DIA. DISCHARGE ROTARY VALVE, SS	1
	AC	4	H17116AC-D00	INLET WAND ASSY, 2", SS	1
	AD	5	H117116AD-D00	FLEXIBLE CONVEY LINE AND SS HOSE CLAMPS, 2" DIA. X 240" LG.	1

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE ENGLISH (FEET AND/OR INCHES)
TOLERANCES

DECIMALS	INCHES	FEET	ANGLES
.X ±.030" .XX ±.015" .XXX ±.005"	X/X" = ± 1/16"	.X'-X" = ± 1/4" UP TO 20 FEET .X'-X" = 1/2" OVER 20 FEET	± .1'

DO NOT SCALE DRAWING | **REMOVE ALL SHARP EDGES**

HAPMAN
Ideas that move
5944 E. N AVE. KALAMAZOO, MICHIGAN 49048
PHONE (269) 343-1675 FAX (269) 349-2477

DATE: 5/14/2018 | JOB NO.: H1711600 | DRAWN: jbouchard
SCALE: | WEIGHT: N/A

TITLE: VACUUM CONVEYING SYSTEM

CUSTOMER: VEOLIA WATER TECHNOLOGIES CANADA INC.

SHEET 1 OF 1 | DRAWING NO.: H1711600-D00 | A

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HAPMAN
Ideas that move

Vacuum Conveyor

Installation, Operation and Maintenance Manual

www.hapman.com

All owners and operators should read this manual and/or be instructed on safe operating and maintenance procedures before attempting to uncrate, install, operate, adjust or service this equipment

Following are symbols used in this manual along with a description of their meanings:

DANGER
Indicates an imminently hazardous situation which, if not avoided, will result in death or severe injury.

WARNING
Indicates a potentially hazardous situation which, if not avoided, will result in death or severe injury

CAUTION
Indicates a potentially hazardous situation which, if not avoided, may result in minor/moderate injury and/or damage to equipment.

HAPMAN

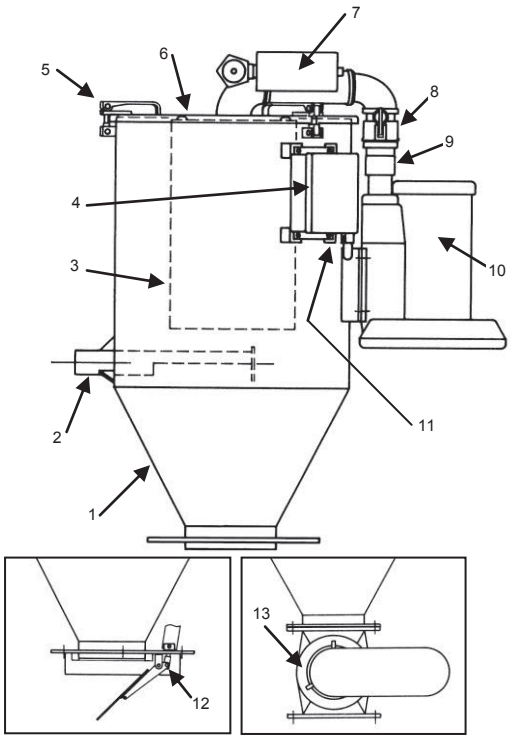
MiniVac™ PNEUMATIC CONVEYOR

Table of Contents

Major Features Index

1. Filter Plenum
2. Material Inlet
3. Cartridge Filter
4. Solenoid Cabinet (If Required)
5. Cam Latch
6. Removable Top Cover (Lid Assembly)
7. Pulse Air Reservoir
8. Quick Disconnect
9. Vacuum Breaker (If Required)
10. Regenerative Blower
11. 80 PSI (Dry) Air Connection
12. Discharge Gate
13. Rotary Valve

NOTE: The marker numerical designations listed in this illustration are for reference purposes only within this manual.



1.0 Warranty

Equipment manufactured by Hapman is warranted to be free of defective material and workmanship under the use and service quoted for a period of one year after date of shipment. This warranty is void if serviced by anyone other than Hapman service personnel.

Hapman agrees to replace or repair any defective parts it has manufactured as covered under this warranty. F.O.B. our plant, subject to inspection of the part in question by Hapman's personnel. No article may be returned to Hapman without Hapman's written consent.

Parts supplied but not manufactured by Hapman are subject to the warranties extended to Hapman by its suppliers. Hapman's liability is limited to such adjustment as the respective manufacturer makes to the seller.

In no event shall Hapman be liable for costs incurred due to equipment malfunction such as consequential damages, lost production or the expenses or losses incurred due to geographical location or fault of the product, difficulty of access to the product as installed, or time urgency on the part of the user and/or buyer of the equipment.

NOTICE:
While all information in this manual has been checked for accuracy, changes in design or specifications may occur at any time in HAPMAN's continuing program of product improvement. HAPMAN cannot assume responsibility for errors in the production of this manual, or for unsafe operating practice of those employing HAPMAN equipment.

WARNING

BEFORE INSTALLING, OPERATING OR MAINTAINING ANY EQUIPMENT, THE CONTENTS OF THIS MANUAL SHOULD BE THOROUGHLY REVIEWED AND UNDERSTOOD.

Statements and instructions set forth herein are based upon the best information and practices known to HAPMAN, but this may not be construed to suggest that every conceivable safety precaution is contained herein. As a matter of practicality, HAPMAN cannot guarantee that actions in accordance with such statements and instructions will result in the complete elimination of all hazards and thus assumes no liability for accidents which may occur.

For further information regarding installation, operation and maintenance please contact the factory service department.

HAPMAN Customer Service
5944 East N Avenue, Kalamazoo, MI 49048-2321 (US/Can): 800.427.6260
Phone: 269.343.1675, Fax: 269.382.8266 E-mail: service@hapman.com

2.0 Safety Instructions

CAUTION

All Hapman furnished equipment must be installed, operated and maintained in accordance with service instructions. Failure to follow these instructions may result in serious personal injury or property damage.

2.1 Once the pneumatic conveyor (sometimes referred to as the MiniVac™) has been properly positioned in the desired location, it must be securely fastened (anchored) to approved structural supporting beams or equipment before connecting the electric and air utilities.

2.2 Installation, operation and maintenance of electrical machinery must be performed only by qualified, trained and experienced personnel. Make sure that the motor and conveyor body is effectively grounded in accordance with OSHA safety and health standards, the National Electric Code and local codes.

2.3 Avoid physical contact in and around the pneumatically operated discharge gate because it can cause injury to the operator when it closes. The gate can severely pinch fingers and hands when it is activated.

2.4 Likewise, when a rotary valve is used for controlled discharge of product, it too can present a significant “pinch-point” hazard.

2.5 Keep clothing, hair, hands and other body parts away from the rotary valve and receiving pickup wand when the unit is operational.

2.6 Do not manually override or electrically bypass any protective device.

2.7 Periodically inspect the bolts and welds of the frame to ensure their continued integrity and tightness.

WARNING

2.8 Do not attempt to open, work on, clean, service, remove any protective cover, guard, or maintenance panel on the pneumatic conveyor until the **POWER IS TURNED OFF AND LOCKED OUT.**

2.9 Use extreme care and caution when handling combustible dusts, powders, and vapors because such conditions can introduce a potential fire/explosive hazard which may be caused by sparks (electrical, electrostatic, metal against metal) in the filter receiver or transport pipe.

Pneumatic filter receivers do not contain extinguishing or suppression equipment.

Should combustible dusts or explosive vapors be introduced to the conveyed material, consult NFPA (National Fire Prevention Association) guideline for recommended explosion relief (vent) devices and/or fire extinguishing equipment. Hapman conveyor equipment hoppers, filter/receivers and dust collectors do not contain explosion relief vents, except on special order.

2.10 Any equipment which is used in the processing or transporting of explosive materials in hazardous environments requires an evaluation on the part of the user and operator or proper and adequate equipment enclosures. Do not use your equipment in hazardous environments unless it has been properly equipped for the hazard.

2.11 Protective gloves, breathing masks, and other protective clothing required for the material being conveyed must be worn when using the pickup wand and when changing the cartridge filter to prevent over exposure to the material.

2.12 It is ultimately the operator's responsibility to implement the above-listed precautions and ensure proper use of the equipment. Keep these instructions and list of warnings with your machines at all times. **WORK SAFELY AT ALL TIMES**.

3.0 General Description and Installation

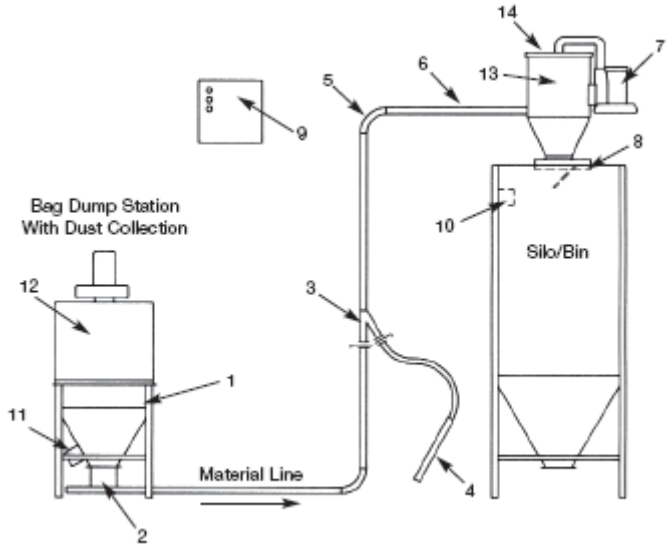
Designed for in-plant handling of most dry solids and powders, Hapman Mini-Vacuum conveyors deliver high performance, ultra-compact size, and cost effectiveness. Operating under negative pressure, or "vacuum"; material is drawn directly into the conveying line by airflow via pick up nozzle or hopper. Product loss and dusting is minimal as accidental leakage is drawn inward, providing maximum safety in handling toxic products.

The Hapman Mini-Vacuum system is particularly adaptable to providing material pick up from single or multiple hoppers, or open containers and delivering to one discharge point. Material laden air is transported through the line by induced air flow created by a positive-displacement blower or regenerative centrifugal fan. Material/air separation and discharge is accomplished by Hapman's compact receiver unit. The Hapman receiver provides highly-efficient final filtration through application of cartridge-type filtration technology.

Available in both standard and custom arrangements, each Hapman pneumatic conveyor system is designed for your specific application. The success of your conveyor installation will be dependent on understanding the operation of each component and its operation.

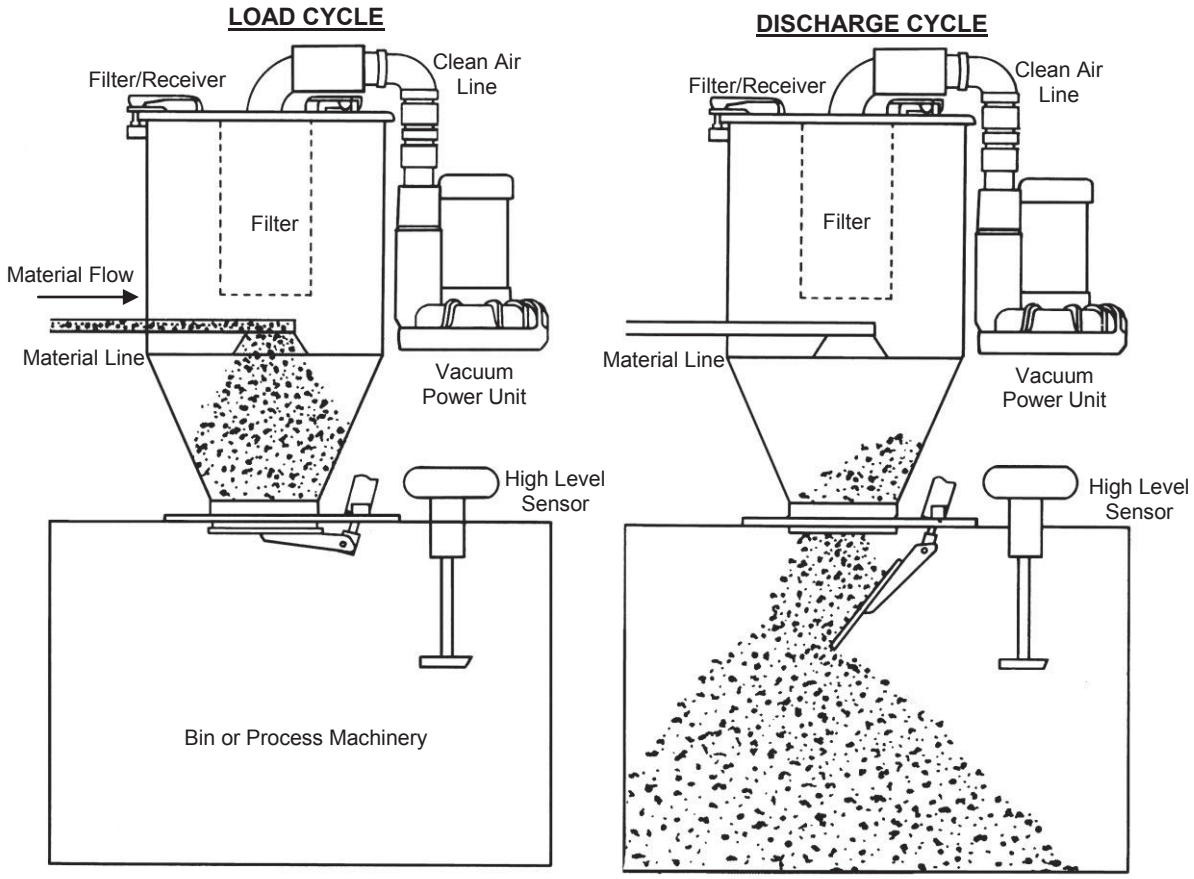
Please review the following guidelines when installing your pneumatic conveyor system. In addition, carefully review specific construction drawings that have been prepared by Hapman engineers for your applications.

TYPICAL SYSTEM COMPONENTS
Figure 7



1. Air Intake
2. Self-Feeding Material Intake
3. Y Branch
4. Pick-Up Wand
5. Elbow
6. Transport Pipe
7. Regenerative Blower
8. Discharge Gate
9. Control Panel
10. High Level Sensor-Silo
11. Low Level Probe-Material Inlet
12. Bag Dump Station
13. Filter Receiver
14. Receiver Lid

4.0 Hapman Pneumatic Conveyor Equipment



Hapman's miniature filter receiver units provide efficient separation and collection of air-borne solids that have been introduced into the conveying system. The air/material mixture enters the receiver plenum chamber and immediately begins to decelerate. Larger particles quickly fall from the air stream and collect in the receiver. Smaller particles remain entrained in the air flow, migrating upward and collecting on the filter media. The filtered air passes up through the receiver "lid" and continues to the vacuum blower inlet.

Collected dust begins to densify on the filter membrane. A solid state timer periodically energizes a solenoid operated air valve resulting in a burst of compressed air directed into the inside of the cartridge filter. The compressed air expands inside the filter and provides a momentary reverse air flow across the filter membrane. This dislodges the collected dust which falls into the receiver. The filter is now clean and resumes collecting dust from the conveying air stream.

NOTE: The filter cartridge, when reversed pulsed, may contain a significant amount of the material being conveyed. This material accumulates within the filter pleats and on end-caps. It is normal for the cartridge to look "dirty" as the material buildup densifies. This buildup of densified conveyed material actually aids in the air/material separation. The Hapman MiniVac™ receiver includes a side access door for filter access and ease of cleaning. See Major Features Index on Page 4.

Note: When preparing to clean the filter receiver, use extreme care when removing the filter from the filter receiver. Do not rest the filter cartridge on the edge of the receiver housing. The cartridge's delicate filter membrane will be damaged by the exposed receiver housing edge.

4.1 Major Components of Filter/Receiver Unit Include:

Discharge Gate

Standard filter receivers are equipped with a cylinder operated "dump" gate to periodically empty the filter plenum of collected material.

During normal operation, the discharge gate is in the closed position, sealing the receiver chamber. Once closed, a vacuum develops inside the receiver causing the material/air to flow through the transport line. At the beginning of the cycle, a solid state timer (located in the operators control station) energizes. This timer is adjustable; however, the factory setting is 4 seconds.

When the timer de-energizes, two events simultaneously occur. First, the vacuum breaker valve (located on blower inlet) opens and relieves the vacuum from the receiver chamber. In the absence of vacuum, material ceases to flow through the transport line. Next, the discharge gate is signaled to open allowing collected material to discharge from the receiver. After 4 seconds, the discharge gate is signaled to close and prepare for the next conveying cycle. The vacuum breaker valve is held open by a delay timer for a short time period to allow the dump gate to fully close. When the delay timer de-energizes, the vacuum breaker valve is closed and the convey cycle is repeated.

Solenoid Cabinet (Dump Gate model only)

The discharge gate and vacuum breaker valve are cylinder operated and controlled via electrically operated solenoids (110VAC). These solenoids, as well as the filter cleaning pilot solenoid, are mounted and wired inside a NEMA 4 enclosure mounted to the filter/receiver housing. Field wiring and compressed air connections are furnished for ease of installation.

NOTE: Solenoids are equipped with flow control fittings to control the Speed of the cylinder operated discharge gate.

Rotary Discharge Valve

An optional rotary discharge valve may be installed in lieu of a cylinder operated dump valve. This effectively increases the net conveyor capacity by eliminating the delay period necessary for dump gate discharge. The application of a rotary valve is usually limited to fine, free-flowing materials.

The rotary discharge valve provides an airlock seal between the interior of the filter/receiver chamber (under vacuum) and the discharge chute or hopper vessel (ambient pressure).

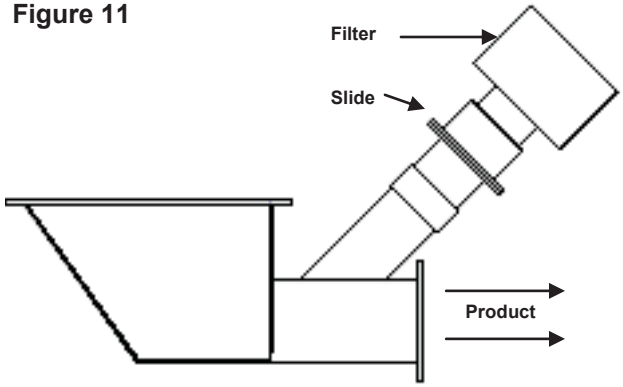
Rotary valves are normally supplied with 1/2 HP gear motor arrangement including shear-pin overload.

5.0 Material Feed Devices

5.1 Flooded Well Inlet

The Hapman flooded well inlet provides a controllable means of introducing most free-flowing solids into the conveying air stream. The inlet is attached to the discharge of material supply hoppers and can be fitted with a cylinder or manually operated shut-off gate to allow several feed points to be arranged on a single vacuum conveyor line.

Figure 11



Its design directs material to the bottom of the pneumatic conveyor line where it is swept away by the conveying air stream. Volumetric feeding is achieved by the natural angle of repose of the material. Adjustable flow rates are achieved by a movable slide. See Figure 11.

5.2 Rotary Inlet Valve (Figure 12)

Rotary valves are often utilized to provide more positive feed control into pneumatic conveyors. This type of valve more readily controls fluid material and prevents surging or flooding the conveyor line. See Figure 12.

5.3 Manual Pickup Wand (Figure 13)

Material can be unloaded from open containers using a hand-held pick-up lance or wand. The wand is constructed of concentric steel tubes which maintain infeed air flow when the wand top is buried deep into the material container. The wand can be adjusted to provide optimum material-to-air ratios to increase or decrease conveying rates as required. See Figure 13.

Figure 12
ROTARY INLET VALVE

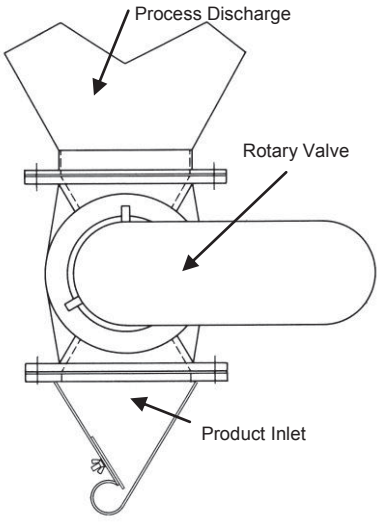
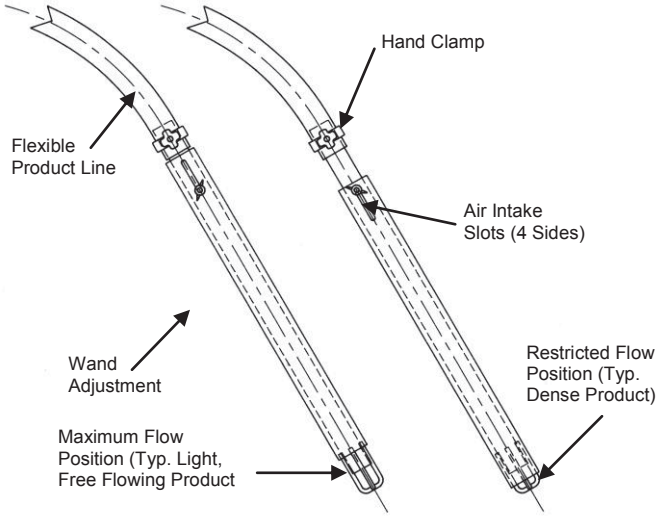


Figure 13
PICKUP WAND



6.0 Blower Packages

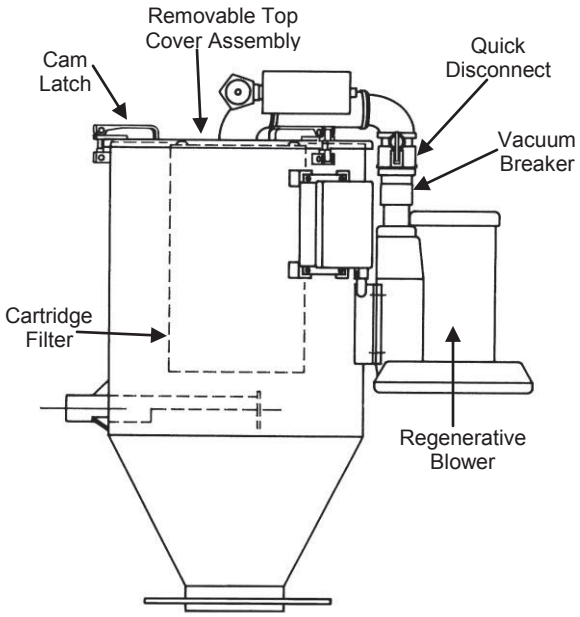
6.1 Regenerative

The regenerative blower utilizes a motor driven impeller that draws in air from the inlet port and then by centrifugal force, accelerates the air out through the discharge.

The regenerative blower works in principle by utilizing an annular shaped housing that turns air back to the base of the following blades where it is again hurled outward. Each regeneration imparts additional pressure to the air until it reaches the discharge where air is then diverted out of the blower.

Each blower is assembled as an integral part of the pneumatic receiver. A quick disconnect-cam/lever type coupling is furnished on the blower inlet. This coupling allows the vacuum line-top cover assembly to be easily removed for inspection of the filter cartridge. See Figure 14.

Figure 14



NOTE: Blower motor must be wired for clockwise rotation and should be verified before running the unit.

6.2 Positive Displacement

A positive displacement system utilizes a rotary blower that is either belt driven or direct coupled to the drive motor. The blower has two impellers rotating in opposite directions. As each impeller lobe passes the blower inlet, air is trapped and routed around the case and to the blower outlet.

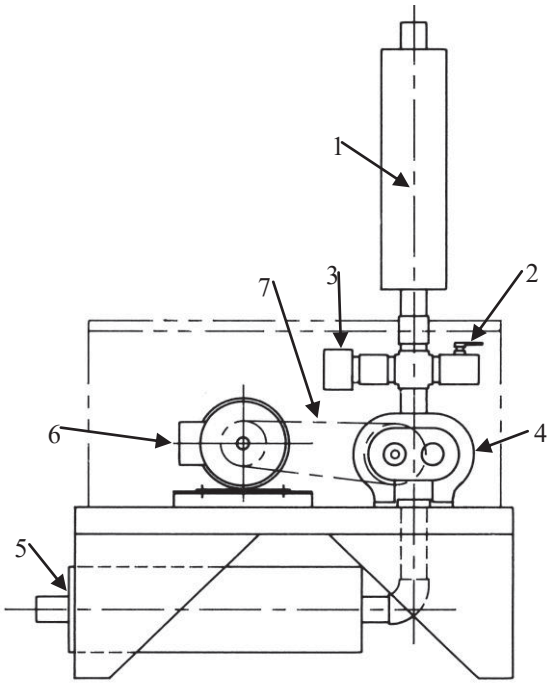
Positive displacement blower systems are normally furnished with inlet and discharge silencers and a foam lined enclosure that will effectively dampen the noise level. A spring loaded vacuum relief valve is furnished in the clean air-vacuum line. The relief valve is factory set at a predetermined value.

The blower system may also be furnished with an auxiliary air inlet valve (manual ball valve). This valve can be used to bleed air into the clean air side of the receiver thus reducing both vacuum and system capacity.

A positive displacement blower system is normally located remote from the pneumatic receiver. Clean air-vacuum piping is furnished either in random lengths or cut to length as dictated by job requirements. A quick disconnect cam/lever type coupling is furnished at the filter receiver-top cover assembly. This coupling allows the vacuum line-top cover to be easily removed for inspection of the filter cartridge. See Figure 16.

Figure 16
POSITIVE DISPLACEMENT SYSTEM

1. Inlet Silencer
2. Auxiliary Air Inlet Valve
3. Vacuum Relief Valve
4. Positive Displacement Blower
5. Discharge Silencer
6. Drive Motor
7. V-Belt



7.0 Electronic Control Systems (Figure 17)

Inlet Rotary Timer:
Delays the starting of the inlet rotary valve after the pneumatic conveyor has started.
Typical setting = 5 seconds

Conveyor Delay Timer:
Delays the starting of the conveyor if a rotary valve is located on the discharge
Typical setting = 3 Seconds

Fill Timer:
When a dump gate is purchased this timer is used to set the fill time in between dumps.
Typical setting = 30 seconds

Dump Timer:
When a dump gate is purchased this timer is used to set the dump duration time.
Typical setting = 4 seconds

Vacuum Break Timer:
Used to set the amount of time the vacuum is vented to atmosphere.
Typical setting is 2 seconds longer then dump timer setting.

Pulse#1 on Timer:
Sets the duration of time an air pulse is delivered to clean filter#1.
Typical setting = 0.5 seconds

Pulse#1 off Timer:
Sets the amount of off time between each pulse for filter#1.
Typical setting = 30 seconds

Pulse#2 on Timer:
Sets the duration of time an air pulse is delivered to clean filter#2.
Typical setting = 0.5 seconds

Pulse#2 off Timer:
Sets the amount of off time between each pulse for filter#2.
Typical setting = 30 seconds

Pulse#3 on Timer:
Sets the duration of time an air pulse is delivered to clean filter#3.
Typical setting = 0.5 seconds

Pulse#3 off Timer:
Sets the amount of off time between each pulse for filter#3.
Typical setting = 30 seconds

Pulse#4 on Timer:
Sets the duration of time an air pulse is delivered to clean filter#4.
Typical setting = 0.5 seconds

Pulse#4 off Timer:
Sets the amount of off time between each pulse for filter#4.
Typical setting = 30 seconds

High level discharge Timer:
This timer is used when there is a high level sensor located at the discharge and when product falls below the high level this timer will start and once expired will restart the pneumatic conveyor
Typical setting = varies per receiver.

Discharge off delay Timer:
When a discharge rotary valve is purchased this timer is used to set the amount of time the discharge rotary valve continues to run after the pneumatic conveyor shuts off allowing the receiver to be emptied
Typical setting = 5 seconds

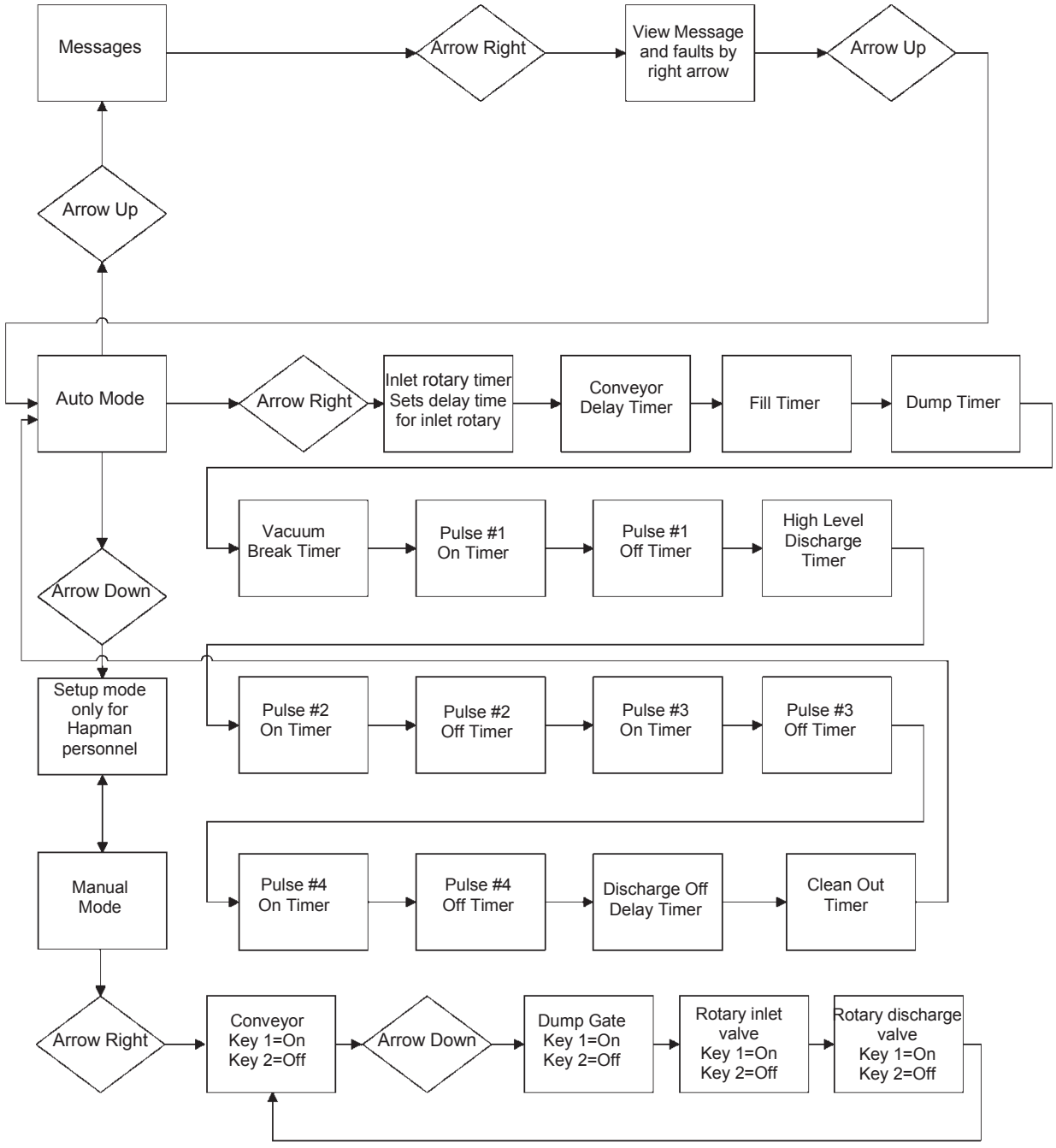
Clean out Timer:
When a dump gate is purchased this timer is used to clean out the pneumatic conveyors pipes in between dumping the product. This timer is only needed when there is long vertical drops.
Typical setting = 5 seconds.

Note:
Depending on options purchased only some of these 1imers will be visible when shipped to the end user.

How to enter values into a Timer:
When the auto mode is showing press right arrow to first Timer then press the 0 key until desired digit then enter correct value. If there is a Timer that you do not want to adjust then just press the enter key then the right arrow.

Isolate and lock power source prior to inspecting control panel wiring. Inspect control panel wiring for tightness

FIGURE 17
PNEUMATIC RECEIVER PLC FLOW DIAGRAM



8.0 Installation Instructions

8.1 Refer to Hapman general arrangement drawings when installing air-handling piping. The material handling capacity of your conveyor system has been calculated based upon a pre-determined number of straight lengths and bends of piping. Deviations or additions to the layout may impact the performance and capacity of the conveyor system. Piping runs should be kept in a horizontal and vertical axis at all times. Avoid sloped routing (upward or downward).

8.2 Inspect your equipment for loosening and breakage that may occur during shipment.
a. Inspect compressed air connections on the filter/receiver for tightness.
b. Check the tightness of the cartridge filter in the filter/receiver chamber.

8.3 Compressed air requirements:
a. Install 1/2" (minimum) air supply line to filter/receiver unit.
b. Compressed air should be 60-80 PSI; the filter/receiver will consume 2-3 SCFM of air (per unit maximum).

NOTE: Install regulator should plant air exceed 90 PSI.

c. Compressed air should be free from water, oil and solids. Oil will eventually plug the filter media and solids may cause solenoid malfunctions.

NOTE: Install a mist eliminator if the plant air quality is poor.

d. If pneumatic conveyor is installed outdoors or in unheated areas, the compressed air must be dried to appropriate dew point to prevent air lines from freezing.

8.4 Control System:

Isolate and lock power source prior to inspecting control panel wiring. Inspect control panel wiring for tightness. Verify timer settings (see illustrations for correct settings), and reinsert timers and relays that may have loosened during shipment.

8.5 Motor-Driven Devices: Check for correct rotation as indicated by the "rotation" arrow on housings of vacuum blower, fan or rotary valve.

8.6 Re-inspect conveyor piping for tightness, rigidly and leaks. Be sure that all piping connections have static grounding straps correctly installed.

8.7 Adjust, if necessary, flow control valves controlling speed of cylinder operated discharge gate. Gate should not slam open or closed.

8.8 Check lubrication levels, motor driven devices such as gearboxes and positive displacement blowers. Follow suggested lubrication inspection and replenishment according to manufacturer's instructions.

9.0 General Maintenance

An air conveying system that has been properly engineered, checked out, and adjusted for start-up is subject to little trouble. A regular maintenance schedule will help prevent malfunctions.

9.1 Weekly

1. Inspect blower discharge air for presence of dust, indicating filter failure.
2. Inspect compressed air line filter/oil separators for accumulation of oil, water and debris.
3. Check for smooth operation of air operated devices such as slide gates, discharge gates and vacuum breakers.

9.2 Monthly

1. Remove receiver lid and inspect for cartridge filter wear and excessive product buildup on filter media.
   Remove excess product buildup as necessary.
2. Check lubrication levels of positive displacement blower and gear boxes.
   Consult Appendix for further lubrication information.
3. Inspect conveyor piping for leaks and wear.
4. Energize pulse timer circuit (with blower off) and observe operation of the filter cleaning mechanism.

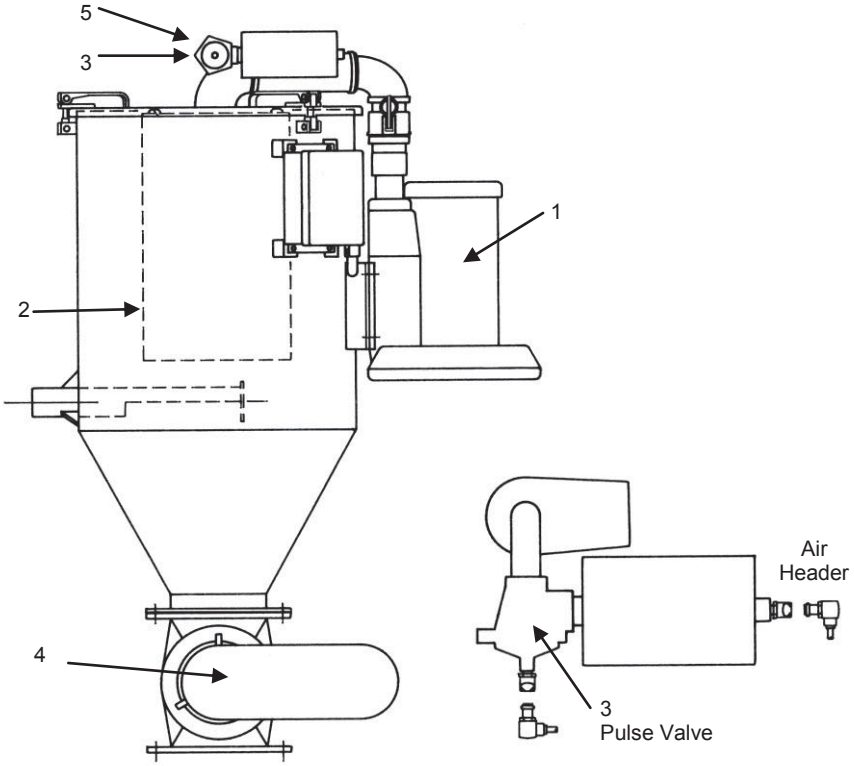
10.0 Replacement Parts for Receiver with Rotary Discharge Valve

When calling or writing for replacement parts, please reference the equipment serial number embossed on the Hapman nameplate affixed to equipment. See back of this manual for phone number and address of Hapman Service.

Hapman Filter Receivers – Rotary Discharge Valve Model "R"					
Item No.	Description	Model			
		16R/20R/24R	30R	36R	42R
1	Blower Assembly	1	1	1	1
2	Filter Cartridge	1	2	3	4
3	Pulse Air Valve	1	2	3	4
4	Rotary Valve	1	1	1	1
5	Solenoid NC 2-Way (Pulse)	1	2	3	4

NOTE: For Replacement Parts and Service for the Filter Receiver Discharge Gate See Page 18

Figure 27
PARTS DIAGRAM FILTER RECEIVER WITH ROTARY DISCHARGE VALVE



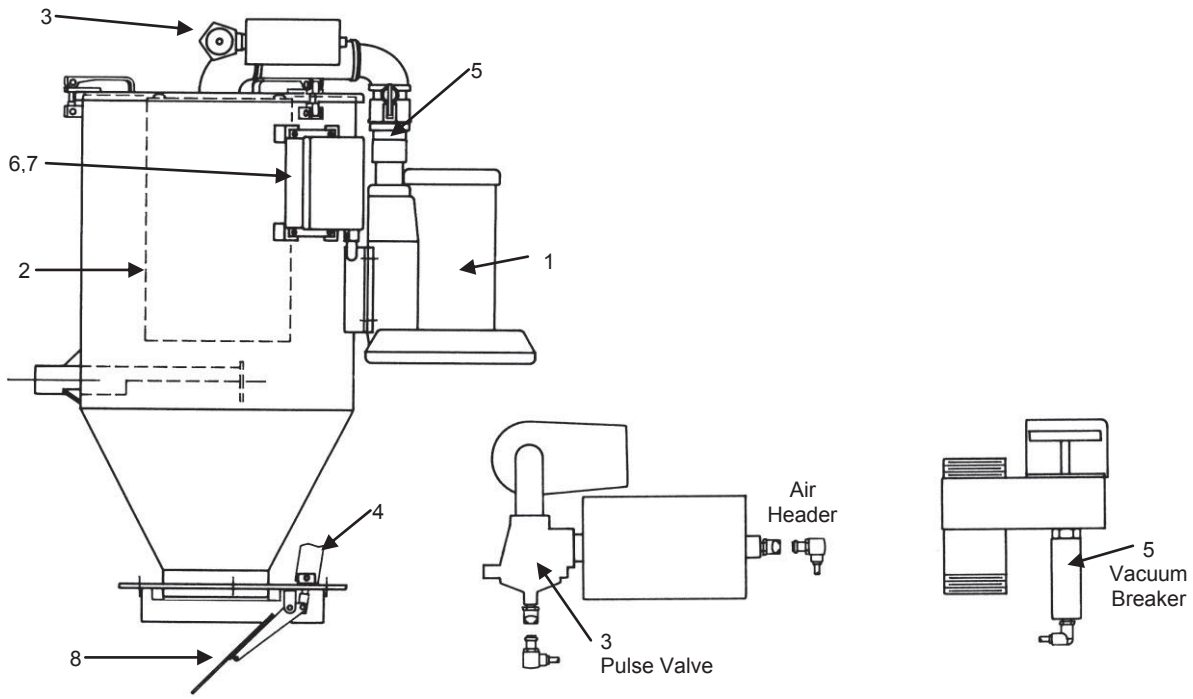
Replacem

When calling or writing for replacement parts, please reference the equipment serial number embossed on the Hapman nameplate affixed to equipment. See back of this manual for phone number and address of Hapman Service.

Hapman Filter Receivers –Discharge Gate Model "D"					
Item No.	Description	Model			
		16D / 20D / 24D	30D	36D	42D
1	Blower Assembly	1	1	1	1
2	Filter Cartridge	1	2	3	4
3	Pulse Air Valve	1	2	3	4
4	Discharge Gate Cylinder	1	1	1	1
5	Vacuum Breaker Cylinder	1	1	1	1
6	Solenoid NC 3-Way (Dump gate, vacuum break)	3	3	3	3
7	Solenoid NC 2-Way (Pulse)	1	2	3	4
8	Discharge Gate	1	1	1	1

Note:
For Replacement Parts and Service for the Filter Receiver Rotary Discharge Valve See Page 17

Figure 28 - PARTS DIAGRAM FILTER RECEIVER WITH DISCHARGE GATE



Record of Important Information for This Machine

Serial Number_____

Model Number_____

For Operational Information in This Plant Contact

Name_____

Department / Phone Number_____

Notes

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

HAPMAN

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Spencer® Vortex® Regenerative Blowers

Serial No: _____

Model No: _____

Installation, Operation and Maintenance Instructions

VB-007

VB-055

Important

Read and become familiar with this manual prior to uncrating and installing your Spencer Vortex Blower. Following the instructions detailed here will help you realize its full potential of efficient service and extended lifespan. Damage resulting from failure to follow correct procedure will void the warranty.

Contents

I. General

Scope
Information contained in this manual relates to Vortex Blowers standard and explosion-proof motor models VB-001S, VB-001, VB-002S, VB-002, VB-003S, VB-003, VB-004S, VB-004, VB-007S, VB-007, VB-019S, VB-019, VB-030S, VB-030, VB-037S, VB-037,VB-055, VB-075, and VB-110.

Limited Warranty
We warrant that this product will be free from defects in material and workmanship for a period of 18 months from date of shipment or 12 months from date of startup, whichever comes first. Within the warranty period, we shall repair or replace F.O.B. our Factory such products that are determined by us to be defective.

This warranty will not apply to any product which has been subjected to misuse, negligence, or accident, or misapplied or improperly installed. This warranty will not apply to any product which has been disassembled, repaired, or otherwise altered by any persons not authorized by the Spencer Vortex Service Department.

On units which include thermal protection, the thermal protection must be connected as recommended.

The guarantee of the motor and control manufacturers will govern the extent of our guarantee on such equipment. Warranty work on motors and controls must be authorized by Spencer and must be performed in an authorized shop as designated by the manufacturers.

The Spencer Turbine Company reserves the right to invoice all expenses incurred when repairs are made in the field at the specific request of the customer.

No assemblies or parts of assemblies will be accepted for repair or replacement under this warranty without prior authorization by The Spencer Turbine Company. For complete warranty information, obtain Spencer's Form 706, "Terms and Conditions of Sales."

Safety Precautions
Power sources, protective devices, and grounding provisions must be in accordance with wiring instructions provided in this manual.

Blower becomes hot during operation and may cause burns if touched.

Do not operate the blower under load conditions which exceed the rated full-load amps on the nameplate.

Do not install the blower in any area which may have an explosive atmosphere or which may contain flammable gases or liquids. Always provide proper ventilation. Do not install in any area which may subject the blower to corrosive liquids. Excessive moisture may cause electrical failure; install the blower in areas free from water or rain. Do not operate blower without motor cooling fan cover, or without impeller end cover.

Before installing blowers with explosion-proof motors, the buyer must check federal, state and local codes to see if such motors are appropriate for the intended application environment. It is the buyer's responsibility to determine the suitability of any product for a particular purpose.

Storage
If machine is to be stored for an extended period of time, it must be carefully protected from dampness and dirt.

II. Installation

Locating, Mounting, Connecting
Ambient temperature at the installed location should not be less than -5˚ F or greater than 104˚ F. Relative humidity should not exceed 80%.

Mount the blower in a horizontal or vertical position as shown in Figure 1. For models VB-055, VB-075 and VB-110, it is recommended to mount in the horizontal position only. Check with factory *prior* to mounting these models vertically.

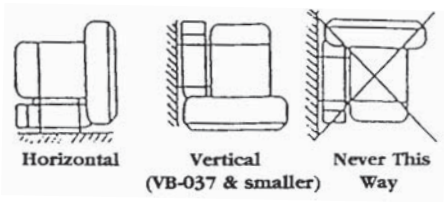


Fig. 1 Mounting Positions

Remove protective coverings, such as vinyl tape or plastic plugs, from the inlet and outlet ports. For models VB-004 and larger, attach to system piping using threaded connection as provided. Avoid excessive stress caused by pipe connector tightening or by misaligned pipe on the inlet and outlet ports. Support piping by brackets or other means. Models VB-001, VB-002 and

VB-003 are supplied with a patented (U.S. Patent 5,791,870) reversible flange with threaded pipe or tubing connections.

In the event the blower is located where dust, fibers, drops of water, or other particulates may be in the airstream, use a filter on the suction side of the piping. If foreign matter enters the impeller, it may clog, jam, or otherwise impair the blower performance.

Wiring

Caution: Confirm that the power source is the same as that indicated on the unit's nameplate. Application of incorrect voltage or improper phase connection may cause motor failure or other damage.

Use conductors and devices (such as the circuit breakers, starters, and switches shown in Figure 3) that are suitable for the applications shown in Tables 1 and 2 and are in compliance with the National Electric Code and applicable local codes and regulations. Motor terminal connections are shown below Table 1.

Provide protection from overheating of the motor windings. Some models are equipped with built-in thermal protectors (see Table 1). Where applicable, connect the leads from the pilot-duty thermal protector to the magnetic starter as shown in Fig. 3.

Check the direction of rotation of the blower.
To reverse the direction or rotation:

1) **for a single-phase motor, interchange motor leads 5 and 8.**
2) **for a three-phase motor, interchange any two of the three line connections.**

Caution: Install a properly-sized overload device and disconnect in accordance with local codes and regulations and dedicated only to the Vortex Blower.

Furnish the Vortex Blower and all associated electrical devices with a proper ground in accordance with all local codes and regulations.

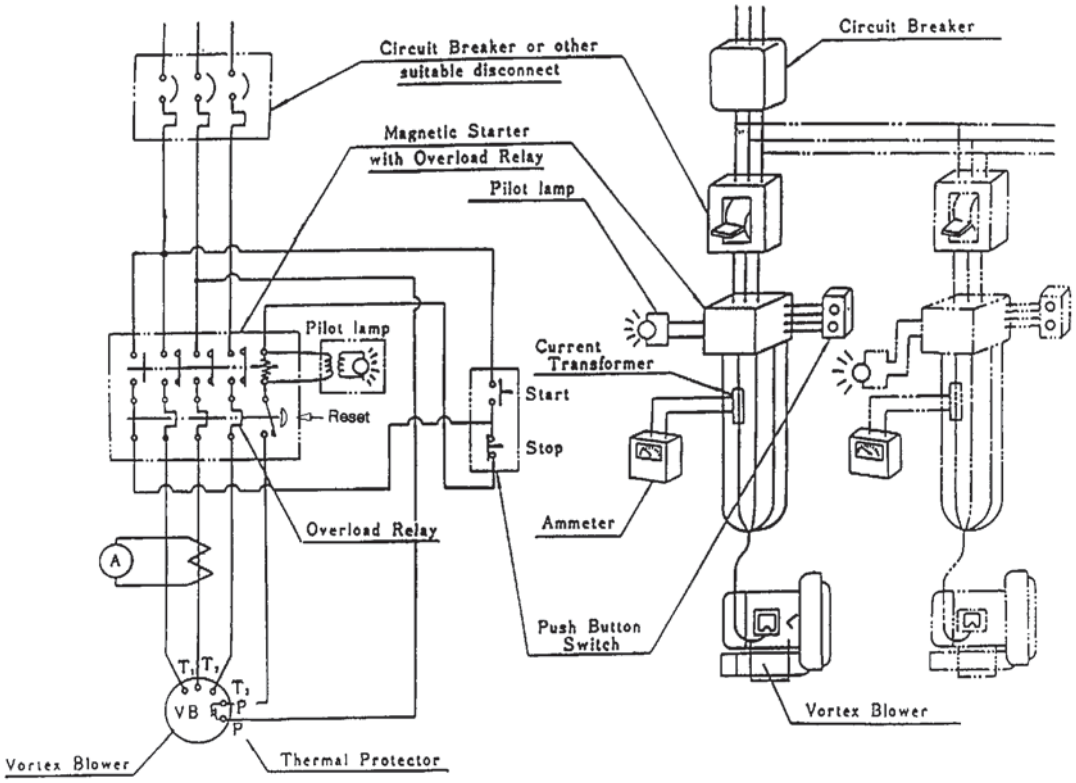


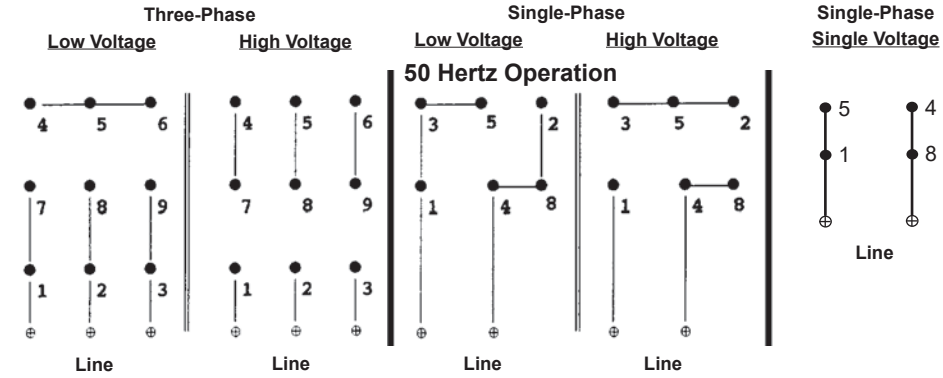
Fig. 3 Typical Wiring Diagram

Table 1 Three-Phase Motor Data - Typical Values

60 Hertz Operation						
Model No.	**VB-001**	**VB-002**	**VB-003**	**VB-004**	**VB-007**	**VB-019**
Power (hp)	0.13	0.25	0.5	0.75	1	2.5
Voltage (V)	200-230/460	200-230/460	208-230/460	200-230/460	200-230/460	200-230/460
FL Amp (A)	.5-.48/.24	.86-.73/.37	1.8-1.6/.8	2.3-2.4/1.2	2.7-2.8/1.4	7.2-6.6/3.3
Voltage (V)		575	575	575	575	575
FL Amp (A)		.4	0.8	0.96	1.4	2.1
Model No.	**VB-030**	**VB-037**	**VB-055**	**VB-075**	**VB-110**	—
Power (hp)	4	5	7.5	10	15	—
Voltage (V)	200-230/460	200-230/460	200-230/460	200-230/460	200-230/460	—
FL Amp (A)	10.6-10.2/5.1	13.2-12/6	19.8-17.2/8.6	27.5-27.2/13.6	39-37/18.5	—
Voltage (V)	575	575	575	575	575	—
FL Amp (A)	3	4.8	7	9.6	13.5	—
50 Hertz Operation						
Model No.	**VB-001**	**VB-002**	**VB-003**	**VB-004**	**VB-007**	**VB-019**
Power (hp)	0.13	0.21	0.5	0.63	.83	2.1
Voltage (V)	190-220/380-415	190-220/380-415	190/380-415	190/380-415	190/380-415	190/380-415
FL Amp (A)	.5-.52/.25-.26	.74-.66/.37-.34	2/1-.9	2.4/1.2-1.3	2.8/1.4-1.5	6.6/3.3-3.1
Model No.	**VB-030**	**VB-037**	**VB-055**	**VB-075**	**VB-110**	—
Power (hp)	3.4	4.2	6.25	8.33	12.5	—
Voltage (V)	190/380-415	190/380-415	190/380-415	190/380-415	190/380-415	—
FL Amp (A)	10.2/5.2-5.1	11.8/5.9-5.6	17.6/8.8-8.2	27/13.5-14.5	36/18-17	—

NOTE: Thermostats are provided on the VB-004 and larger models.

MOTOR WIRING



NOTES: (1) For three-phase, interchange any two line connections to reverse shaft rotation
(2) For single-phase, interchange motor leads 5 and 8 to reverse shaft rotation

THERMOSTATS VB-004 AND LARGER

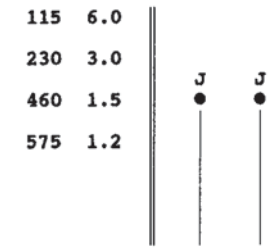


Table 2 Single-Phase Motor Data - Typical Values

60 Hertz Operation								
Model No.	**VB-001S**	**VB-002S**	**VB-003S**	**VB-004S**	**VB-007S**	**VB-019S**	**VB-030S**	**VB-037S**
Power (hp)	0.13	0.25	0.5	0.75	1	2.5	4	5
Voltage (V)	115/230	115/230	115/230	115/208-230	115/208-230	115/208-230	115/208-230	230
FL Amps (A)	1.25/.63	2.3/1.15	5.2/2.6	9.6/5-4.8	12.4/6.5-6.2	22/11.5-11	34.8/18.5-17.4	20.8
Model No.	**VB-001S**	**VB-002S**	**VB-003S**	**VB-004S**	**VB-007S**	**VB-019S**	**VB-030S**	**VB-037S**
Power (hp)	0.13	0.21	0.5	0.63	1	2.1	3.3	4.2
Voltage (V)	110/220	110/220	110/220	100-110/220	100-110/220	100-110/220	100-110/220	220
FL Amps (A)	1.34/.67	2.1/1.05	5.6/2.8	9.9-11.6/5.8	12.7-12.4/6.2	22-21/10.5	42-38.6/19.3	19

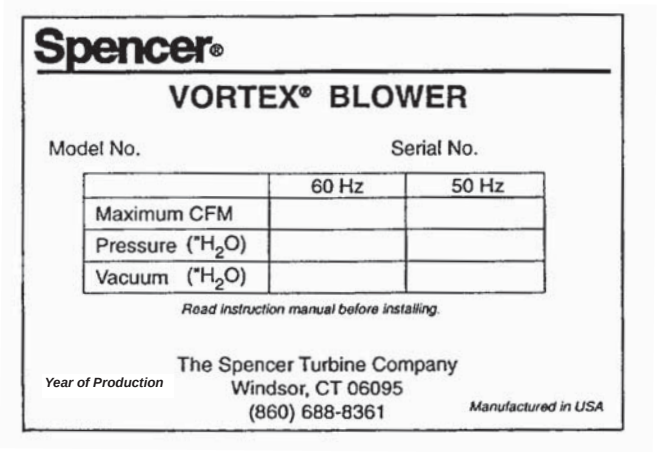


Fig. 4 Typical Nameplate

III. Operation

Limits of Operation

Operation at flows less than those indicated by the solid line on the applicable performance curve will cause overheating of the unit and is to be avoided. Throttling suction or discharge piping to reduce air volume increases differential pressure resulting in elevated temperature and increased power consumption. Use of pressure and/or vacuum relief valve recommended.

Maximum pressure and vacuum are indicated on the nameplate (see Fig. 4). These represent conditions at which the minimum allowable airflow (CFM) occurs. Check the operating pressure or vacuum to assure that the pressure or vacuum remains less than maximum.

For continuous operation at low air volume (on the dotted portion of the performance curve), provide a bypass in the piping and operate at a lower pressure than maximum operating pressure. See Performance Curves, Section V.

Caution: Low flow conditions may produce heat levels which may cause burns. Do not touch the blower in operation.

Temperature Rise

A NEMA Class F insulation system is used in the motor. Maximum allowable winding temperature is 265˚F. If a thermal protector or thermal relay activates because the temperature rise of the motor is higher than usual, investigate and correct the problem. Explosion-proof motors use a NEMA Class B insulation. Typical causes of motor overheating are given in Section VI, Troubleshooting Guide.

IV. Disassembly and Reassembly

A. General

1. Precautions should be taken when disassembling or reassembling the blower. See Warranty Terms.
2. Keep all parts clean.
3. Do not overtighten bolts and screws.

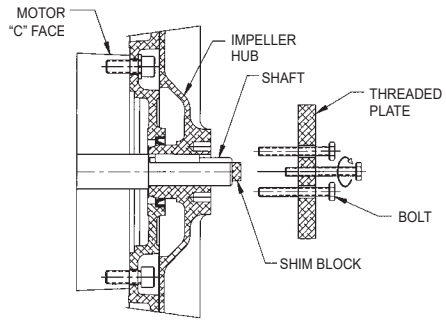


Fig. 5 Impeller Puller

B. Disassembly Procedure (Reassembly is performed in reverse order)

Caution: Shims are used to adjust the gap between the impeller and casing. When disassembling, take care to note the quantity of shims and their thickness. The shim stack replacement must be the correct thickness to assure proper clearance and to avoid degradation of performance.

1. Remove impeller cover; remove screws, pull cover away from case.
2. Unfasten lock washer; remove nut and washer.
3. Remove impeller from shaft by one of the following methods:
   a. manually pull the impeller outward, OR
   b. screw two bolts into tapped holes and pull on the bolts, OR (if the fit is tight)
   c. use a puller assembly (not furnished) as shown in Fig. 5.
4. Remove motor shaft key.
5. Remove case from motor; if necessary remove screws holding case to base and motor to case.
6. Remove shims from motor shaft if necessary; do not discard them. See Note above.

Caution: Motors are heavy. Lift motor on models larger than VB002 by the eyebolt on the motor with an aid from a lifting device.

C. Reassembly Guidance

1. The gap between the impeller and case is essential for proper performance of the unit. The shims between the shaft collar and impeller hub establish the spacing of this gap. In reassembly, before installing the impeller cover, check the gap between the impeller and case to assure that the measurement conforms to the gap specification on the assembly drawing (on the following pages) for your unit.

2. For models VB001, VB002 and VB003, gap clearance between impeller and unibody case should be checked around entire periphery of the impeller in accordance with Item 18, impeller to case gap specification prior to securing impeller.

3 On models VB004 thru VB110 remove Item 23 Plug located on bottom of the case and check impeller gap with a feeler gauge. Remove impeller and adjust shims to meet gap specification. With adjustments and gap check complete, replace plug tightly to prevent air leakage.

4. Fasten impellers using lockwashers and locknuts. Torgue locknut to recommended torque values in Table 3. Bend a lockwasher tab down into a lockwasher slot.

5. Reattach the impeller cover.

Catalog No.	Recommended Torque (Ft-Lb)
VB001, VB001S, VB002 VB002S, VB003, VB003S	22
VB004, VB004S	31
VB007, VB007S	36
VB019, VB019S	36
VB030, VB030S	44
VB037, VB037S	44
VB055	77
VB075	90
VB110	90

Table 3 Locknut Torque

V. Vortex Blower Data

Pages 7 through 17 present information about the various blower models. This information is important in understanding your blower's performance, in using the blower in the proper operating range, and in ordering parts that might be needed.

A. Assembly Diagrams
At the top of each page is an assembly diagram of the unit. Items are identified by circled numbers around the diagram. Above each diagram is the gap specification.

B. Parts Lists
At the lower left of each diagram is a table giving the item number (shown on the Assembly Diagram), the Part No. for that item and the corresponding part description. In ordering parts, provide the model number, the part number and the description.

C. Performance Curves
At the lower right of each diagram are performance curves for 50Hz and 60Hz operation. The curves present the following information:

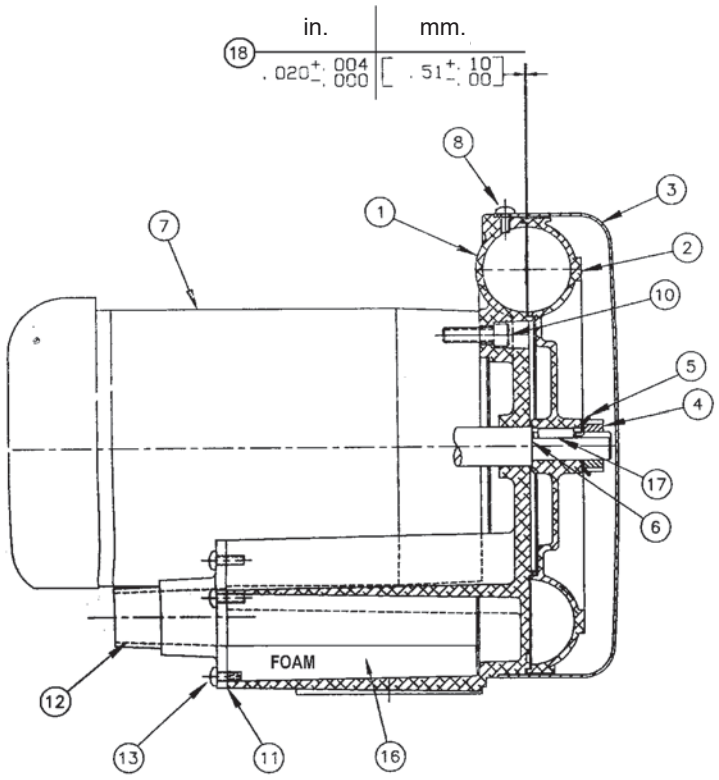
The upper line of each curve is pressure performance while the lower line is vacuum performance. The dashed portion at the left end of some of the curves indicates an intermittent-only operating area. See **Operation** Section on page 5.

D. Estimated Acoustical Noise Level at 1.5M, 60Hz

Model	dba
VB001S	62
VB001	61
VB002S	61
VB002	61
VB003S	66
VB003	66
VB004S	63
VB004	63
VB007S	70
VB007	64
VB019S	70
VB019	73
VB030S	71
VB030	73
VB037S	74
VB037	76
VB055	82
VB075	81
VB110	80

Spencer® Vortex® Regenerative Blowers
VB001S, VB001

Assembly Diagram

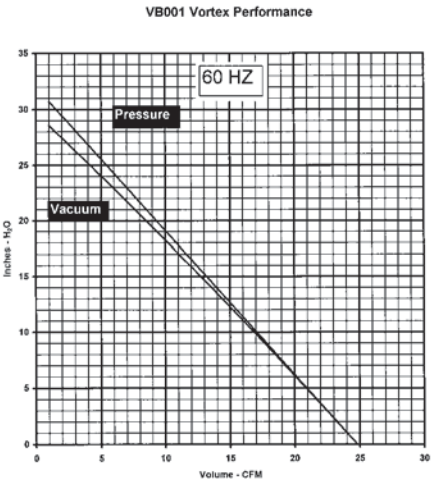


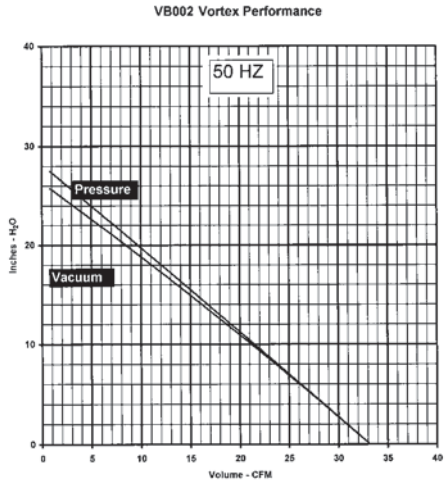
Parts List

DESCRIPTION: VORTEX BLOWER ASSEMBLY – VB001S & VB001			
ITEM	PART NO.	DESCRIPTION	QTY.
1	VBC90101	Case, Unibody	1
2	VBI90101	Impeller	1
3	VBE90101	Cover, Impeller	1
4	NUT90219	Locknut, Shaft	1
5	WSH90184	Lockwasher, Shaft	1
6	WSH90185	Shim, Shaft to Impeller (as required)	1
7	MOT90210	Motor 42C, 1/8 HP, 1PH, 50/60Hz	1
7A	MOT90215	Motor 42C, 1/8 HP, 3PH, 50/60Hz	1
8	SCR90901	M4 x 0.7 Pan Head Phillips Screw x .31 [8] Long	4
10	SCR90307	1/4-20 x .625" Long Socket Cap Screw	4
11	GSK90168	Gasket, Flange	1
12	FLC90013	Flange	1
13	SCR90888	M5 x 0.8 Hex Head Bolt x .63 [16] long	6
16	INS90014	Absorber	2
17	KEY90083	Key	1
18	N/A	Impeller to case gap specification	N/A

VB001S, VB001

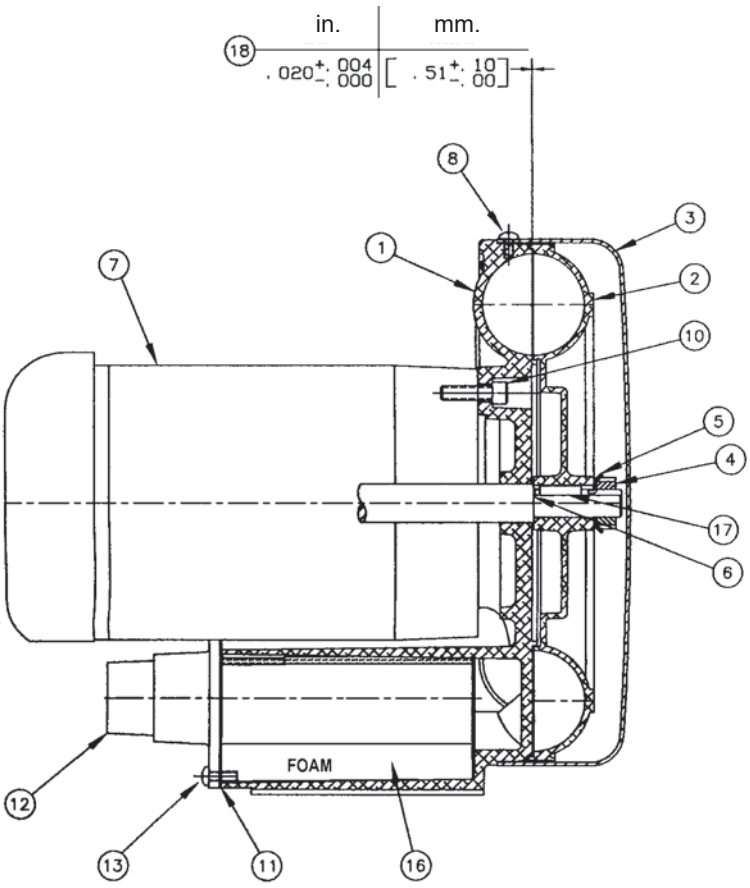
Performance Curves





Spencer® Vortex® Regenerative Blowers
VB002S, VB002

Assembly Diagram

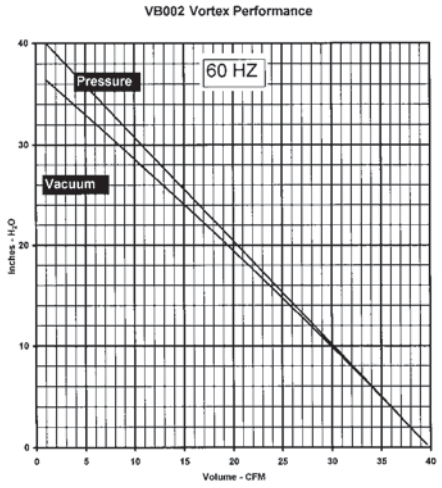


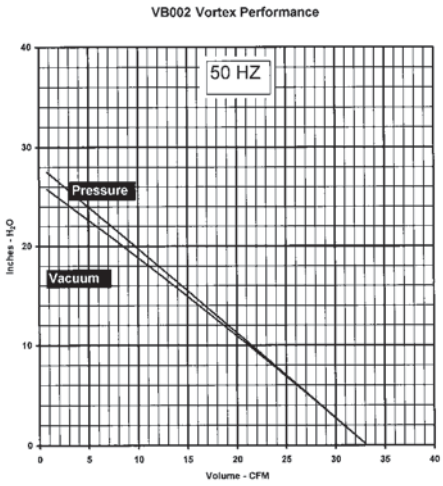
Parts List

DESCRIPTION: VORTEX BLOWER ASSEMBLY – VB002S & VB002			
ITEM	PART NO.	DESCRIPTION	QTY.
1	VBC90201	Case, Unibody	1
2	VBI90201	Impeller	1
3	VBE90201	Cover, Impeller	1
4	NUT90219	Locknut, Shaft	1
5	WSH90184	Lockwasher, Shaft	1
6	WSH90185	Shim, Shaft to Impeller (as required)	1
7	MOT90211	Motor 42C, 1/4 HP, 1PH, 50/60Hz	1
7A	MOT90212	Motor 42C, 1/4 HP, 3PH, 50/60Hz	1
8	SCR90901	M4 x 0.7 Pan Head Phillips Screw x .31 [8] Long	4
10	SCR90307	1/4-20 x .625" Long Socket Cap Screws	4
11	GSK90169	Gasket, Flange	1
12	FLC90014	Flange	1
13	SCR90888	M5 x 0.8 Hex Head Bolt x .63 [16] Long	6
16	INS90015	Absorber	2
17	KEY90085	Key	1
18	N/A	Impeller to case gap specification	N/A

VB002S, VB002

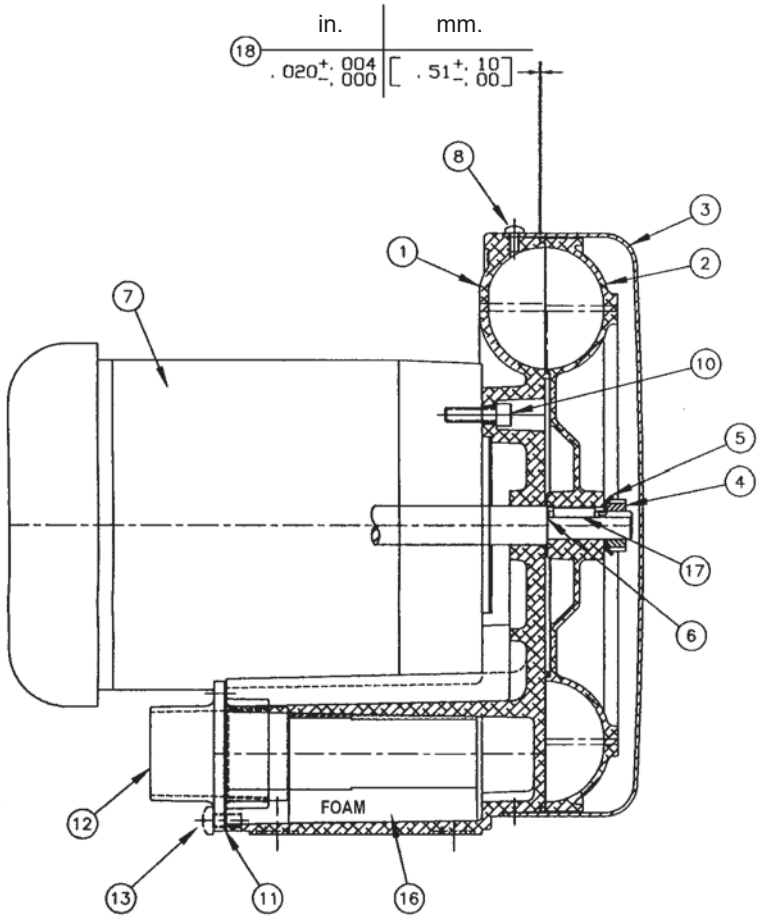
Performance Curves





Spencer® Vortex® Regenerative Blowers
VB003S, VB003

Assembly Diagram

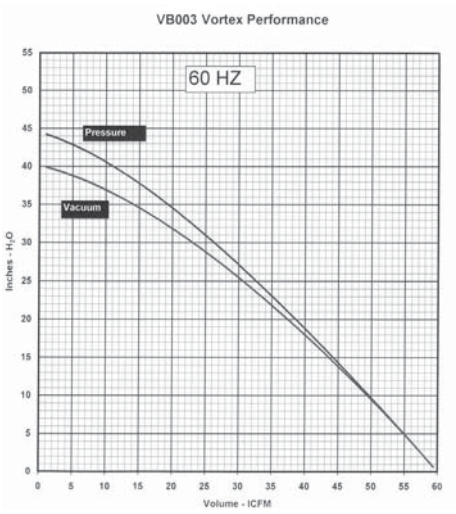


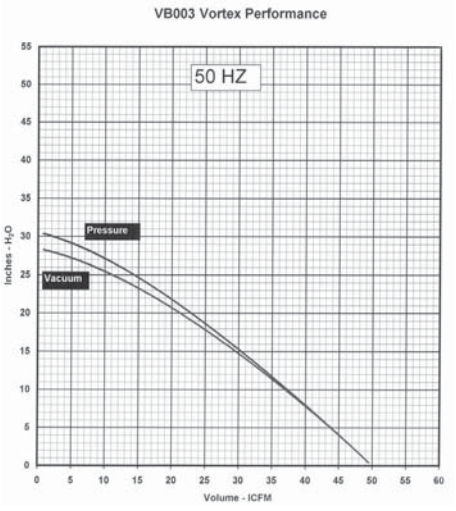
Parts List

DESCRIPTION: VORTEX BLOWER ASSEMBLY – VB003S & VB003			
ITEM	PART NO.	DESCRIPTION	QTY.
1	VBC90301	Case, Unibody	1
2	VBI90301	Impeller	1
3	VBE90301	Cover, Impeller	1
4	NUT90219	Locknut, Shaft	1
5	WSH90184	Lockwasher, Shaft	1
6	WSH90185	Shim, Shaft to Impeller (as required)	1
7	MOT90213	Motor 48C, 1/2 HP, 1PH, 50/60Hz	1
7A	MOT90214	Motor 48C, 1/2 HP, 3PH, 50/60Hz	1
7B	MOT90229	Motor 48C, 1/2 HP, 3PH, 575 Volt, 50/60Hz	1
7C	MOT90470	Motor 48C, 1/2 HP, 3PH, 60Hz	1
7D	MOT90469	Motor 48C, 1/2 HP, 1PH, 60Hz	1
8	SCR90901	M4 x 0.7 Pan Head Phillips Screw x .31 [8] Long	4
10	SCR90307	1/4-20 x .625" Long Socket Cap Screw	4
11	GSK90170	Gasket, Flange	1
12	FLC90015	Flange	1
13	SCR90888	M5 x 0.8 Hex Head Bolt x .63 [16] Long	6
16	INS90016	Absorber	2
17	KEY90085	Key	1
18	N/A	Impeller to case gap specification	N/A

VB003S, VB003

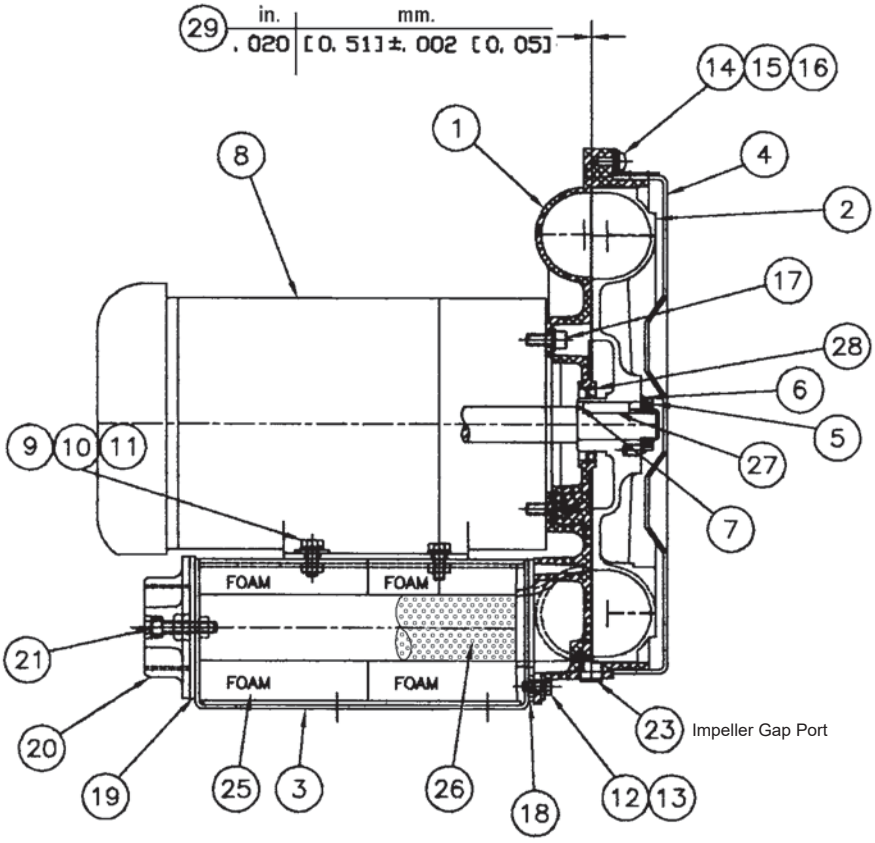
Performance Curves





Spencer® Vortex® Regenerative Blowers
VB004S, VB004

Assembly Diagram

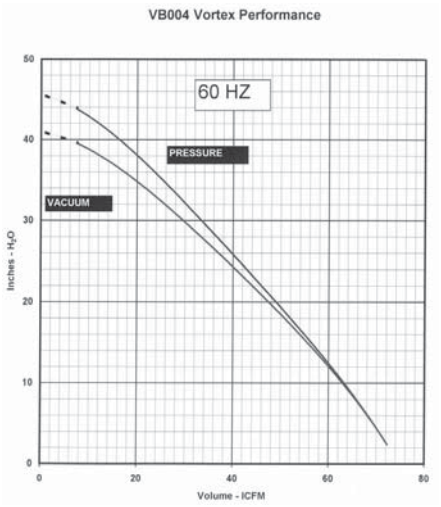


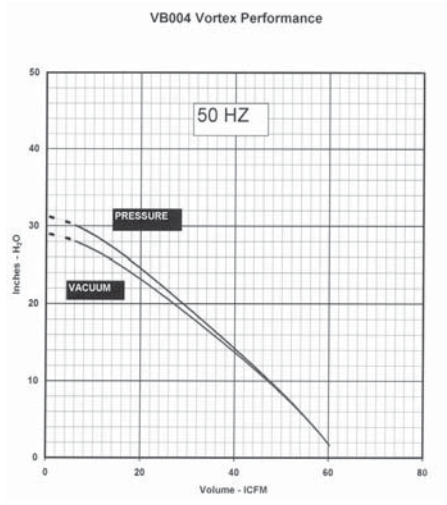
Parts List

DESCRIPTION: VORTEX BLOWER ASSEMBLY – VB004S & VB004			
ITEM	PART NO.	DESCRIPTION	QTY.
1	VBC90401	Case	1
2	VBI90401	Impeller	1
3	VBB90401	Base	1
4	VBE90401	Cover, Impeller	1
5	NUT90212	Locknut, Shaft	1
6	WSH90170	Lockwasher, Shaft	1
7	WSH90177	Shim, Shaft to Impeller (as required)	1
8	MOT90193	Motor 48C, 3/4 HP, 1PH, 50/60Hz	1
8A	MOT90192	Motor 48C, 3/4 HP, 3PH, 50/60Hz	1
8B	MOT90230	Motor 48C, 3/4 HP, 3PH, 575 Volt, 50/60Hz	1
8C	MOT90471	Motor 48C, 3/4 HP, 3PH, 60Hz	1
8D	MOT90472	Motor 48C, 3/4 HP, 1PH, 60Hz	1
9	SCR90887	M6 x 1.0 Hex Head Bolt x .63 [16] Long	4
10	WSH90142	Lock washer, M5	4
11	WSH90166	Flat Washer, M5	4
12	SCR90888	M5 x 0.8 Hex Head Bolt x .63 [16] Long	2
13	WSH90181	Flat Washer, M5	2
14	SCR90877	M5 x 0.8 Pan Head Phillips Screw x .39 [10] Long	4
15	WSH90138	Lockwasher, M5	4
16	WSH90139	Flat Washer, M5	4
17	SCR90307	1/4-20 x .625" Long Socket Cap screw	4
18	GSK90165	Gasket, Case	1
19	GSK90163	Gasket, Flange	2
20	FLC90007	Flange	2
21	SCR90931	M6 x 1.0 S.H.C.S. x .98 [25] Long	4
23	PLG90037	Plug, 1/4 NPT x .43 [11] Long	1
25	INS90017	Absorber	4
26	SCN90065	Screen	2
27	KEY90076	Key	1
28	SEL90108	Lip Seal	1
29	N/A	Impeller to case gap specification	N/A

VB004S, VB004

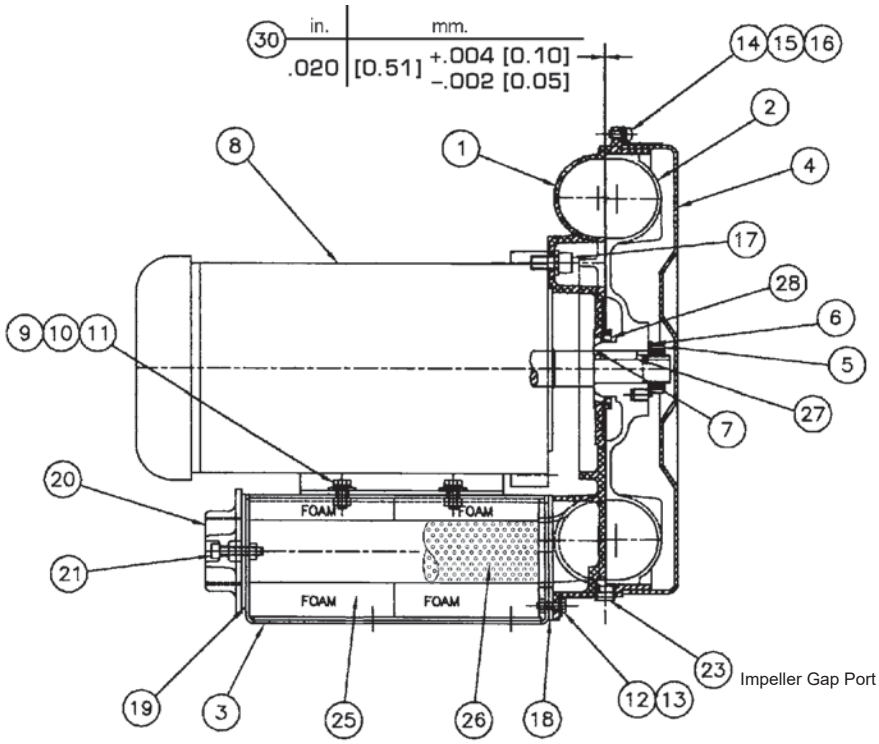
Performance Curves





Spencer® Vortex® Regenerative Blowers
VB007S, VB007, VB007SXP, VB007XP

Assembly Diagram



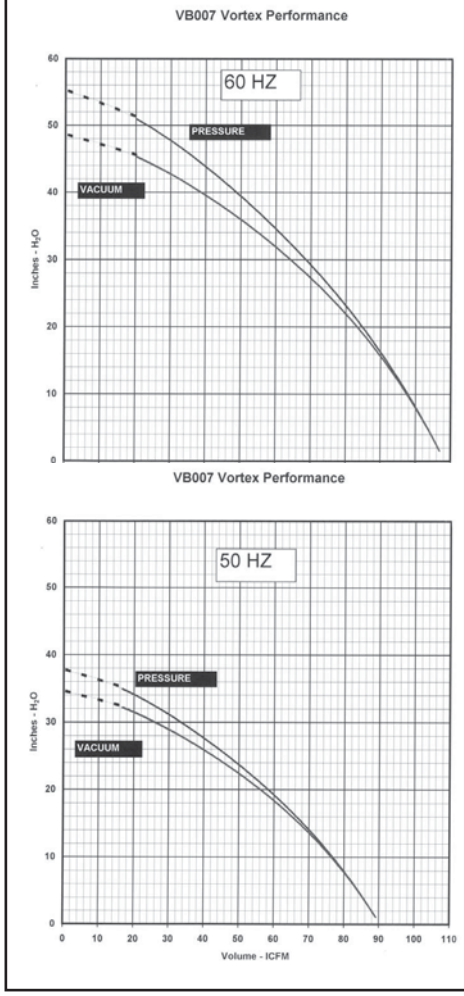
(See Bulletin 417, pages 34 and 35 for specifics on models with explosion-proof motors.)

Parts List

DESCRIPTION: VORTEX BLOWER ASSEMBLY – VB007S, VB007, VB007SXP, VB007XP			
ITEM	PART NO.	DESCRIPTION	QTY.
1	VBC90701	Case	1
2	VBI90701	Impeller	1
3	VBB90701	Base	1
4	VBE90701	Cover, Impeller	1
5	NUT90210	Locknut, Shaft	1
6	WSH90171	Lockwasher, Shaft	1
7	WSH90160	Shim, Shaft to Impeller (as required)	1
8C	MOT90225	Motor, 56C, 1-1/2 HP, 3PH, XP, 50/60Hz	1
8D	MOT90358	Motor, 56C, 1-1/2 HP, 1PH, XP, 50/60Hz	1
8G	MOT90248	Motor, 56C, 1-1/2 HP, 3PH, 50/60Hz	1
8H	MOT90253	Motor, 56C, 1-1/2 HP, 1PH, 50/60Hz	1
8I	MOT90485	Motor, 56C, 1-1/2 HP, 3PH, 60Hz	1
8J	MOT90484	Motor, 56C, 1-1/2 HP, 1PH, 60Hz	1
9	SCR90887	M6 x 1.0 Hex Head Bolt x .63 [16] Long	4
10	WSH90142	Lockwasher, M6	4
11	WSH90166	Flat Washer, M6	4
12	SCR90888	M5 x 0.8 Hex Head Bolt x .63 [16] Long	2
13	WSH90181	Washer, Flat M5	2
14	SCR90877	M5 x 0.8 Pan Head Phillips Screw x .39 [10] Long	4
15	WSH90138	Lockwasher, M5	4
16	WSH90139	Flat Washer, M5	4
17	SCR90867	3/8-16 x .75" Long Socket Cap Screw	4
18	GSK90164	Gasket, Case	1
19	GSK90163	Gasket, Flange	2
20	FLC90008	Flange, 1 1/2 FNPT	2
21	SCR90931	M6 x 1.0 S.H.C.S. x .98 [25] Long	4
23	PLG90037	Plug, 1/4 NPT x .43 [11] Long	1
25	INS90018	Absorber	4
26	SCN90064	Screen	2
27	KEY90076	Key	1
28	SEL90107	Lip Seal	1
30	N/A	Impeller to case gap specification	N/A

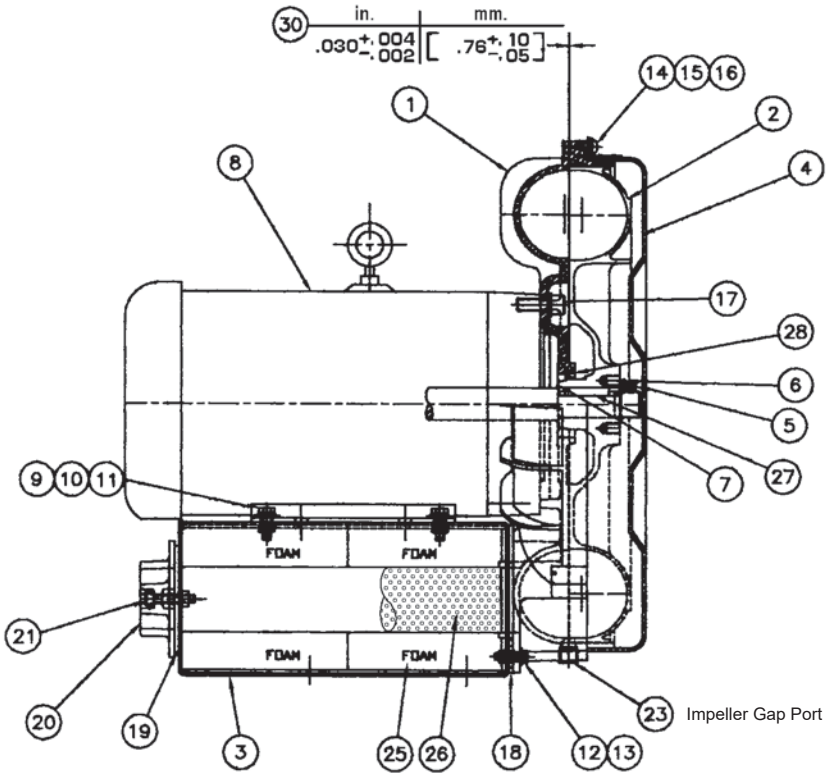
VB007S, VB007

Performance Curves



Spencer® Vortex® Regenerative Blowers
VB019S, VB019, VB019SXP, VB019XP

Assembly Diagram



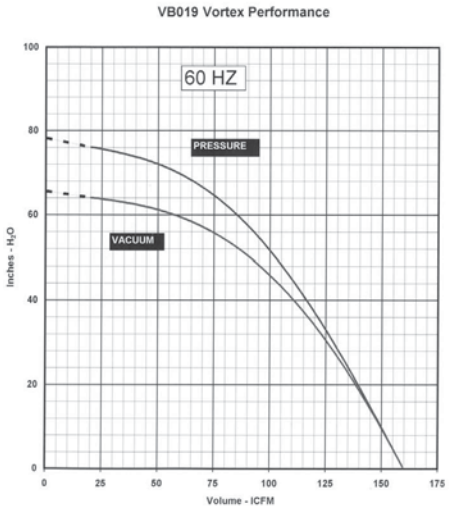
(See Bulletin 417, pages 36 and 37 for specifics on models with explosion-proof motors.)

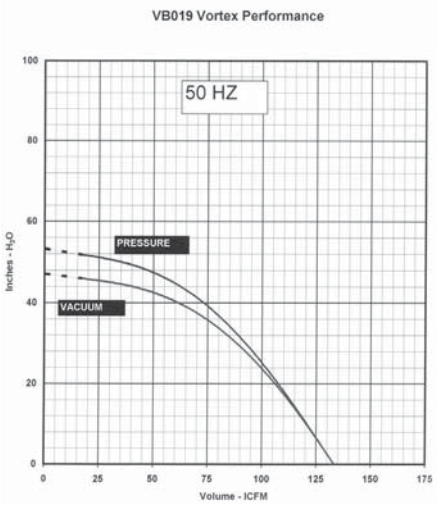
Parts List

DESCRIPTION: VORTEX BLOWER ASSEMBLY – VB019S, VB019, VB019SXP, VB019XP			
ITEM	PART NO.	DESPCRIPTION	QTY.
1	VBC91901	Case	1
2	VBI91901	Impeller	1
3	VBB91901	Base	1
4	VBE91901	Cover, Impeller	1
5	NUT90210	Locknut, Shaft	1
6	WSH90171	Lockwasher, Shaft	1
7	WSH90160	Shim, Shaft to Impeller (as required)	1
8	MOT90254	Motor, 145TC, 2-1/2 HP, 1PH, 50/60Hz	1
8A	MOT90249	Motor, 145TC, 2-1/2 HP, 3PH, 50/60Hz	1
8B	MOT90347	Motor, 145TC, 2-1/2 HP, 3PH, 575 Volt, 50/60Hz	1
8C	MOT90224	Motor, 145TC, 2-1/2 HP, 3PH, XP, 50/60Hz	1
8D	MOT90359	Motor, 145TC, 2-1/2 HP, 1PH, XP, 50/60Hz	1
8E	MOT90476	Motor, 145TC, 2-1/2 HP, 3PH, 60Hz	1
8F	MOT90475	Motor, 145TC, 2-1/2 HP, 1PH, 60Hz	1
9	SCR90887	M6 x 1.0 Hex Head Bolt x .63 [16] Long	4
9ALT	SCR90876	M6. x 1.0 Hex Head Bolt x .98 [25] Long (Cast Motor)	4
10	WSH90142	Lockwasher, M6	4
11	WSH90166	Flat Washer, M6	4
12	SCR90943	M5 x 0.8 Hex Head Bolt x .79 [20] Long	2
13	WSH90181	Flat Washer, M5	2
14	SCR90877	M5 x 0.8 Pan Head Phillips Screw x .39 [10] Long	4
15	WSH90138	Lockwasher, M5	4
16	WSH90139	Flat Washer, M5	4
17	SCR90867	3/8-16 x .75" Long Socket Cap Screw	4
18	GSK90162	Gasket, Case	1
19	GSK90163	Gasket, Flange	2
20	FLC90008	Flange, 1 1/2 FNPT	2
21	SCR90931	M6 x 1.0 S.H.C.S. x .98 [25] Long	4
23	PLG90037	Plug, 1/4 NPT x .43 [11] Long	1
25	INS90019	Absorber	4
26	SCN90063	Screen	2
27	KEY90077	Key	1
28	SEL90107	Lip Seal	1
30	N/A	Impeller to case gap specification	N/A

VB019S, VB019

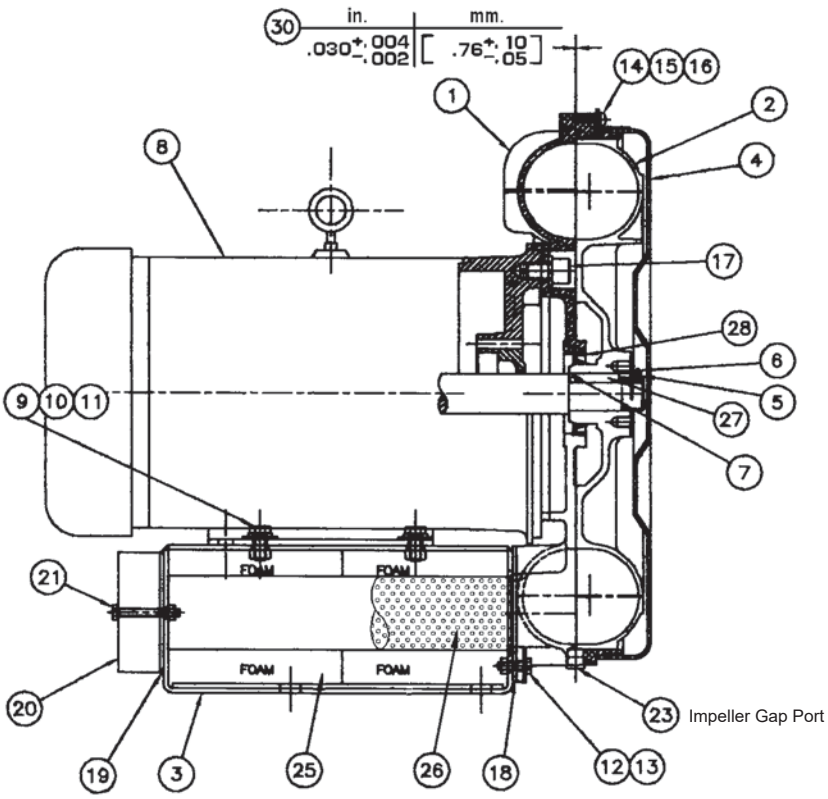
Performance Curves





Spencer® Vortex® Regenerative Blowers
VB030S, VB030, VB030XP

Assembly Diagram



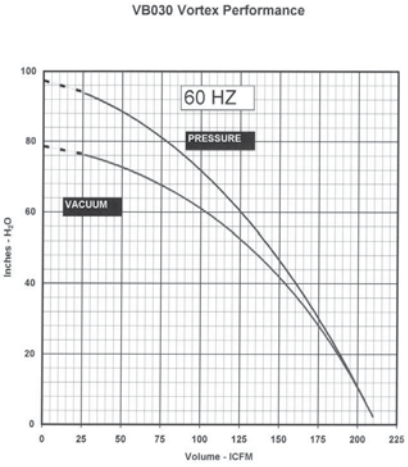
(See Bulletin 417, pages 38 and 39 for specifics on models with explosion-proof motors.)

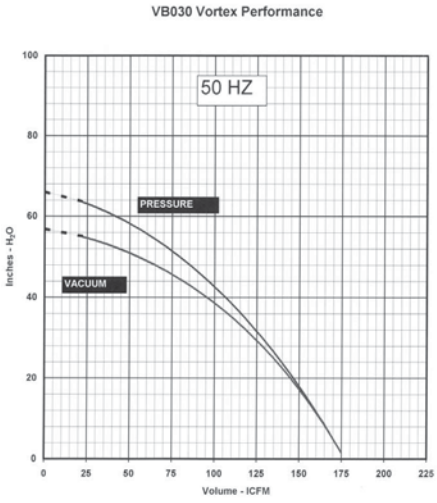
Parts List

DESCRIPTION: VORTEX BLOWER ASSEMBLY – VB030S, VB030, VB030XP			
ITEM	PART NO.	DESCRIPTION	QTY.
1	VBC93001	Case	1
2	VBI93001	Impeller	1
3	VBB93001	Base	1
4	VBE93001	Cover, Impeller	1
5	NUT90209	Locknut, Shaft	1
6	WSH90172	Lockwasher, Shaft	1
7	WSH90157	Shim, Shaft to Impeller (as required)	1
8	MOT90370	Motor, 184TC, 4 HP, 1PH, 50/60Hz	1
8A	MOT90250	Motor, 182TC, 4 HP, 3PH, 50/60Hz	1
8B	MOT90348	Motor, 182TC, 4 HP, 3PH, 575 Volt, 50/60Hz	1
8C	MOT90223	Motor, 182TC, 4 HP, 3PH, XP, 50/60Hz	1
8D	MOT90478	Motor, 182TC, 4 HP, 3PH, 60Hz	1
8E	MOT90477	Motor, 182TC, 4 HP, 1PH, 60Hz	1
9	SCR90879	M8 x 1.25 Hex Head Bolt x .98 [25] Long	4
10	WSH90148	Lockwasher, M8	4
11	WSH90182	Flat Washer, M8	4
12	SCR90876	M6 x 1.0 Hex Head Bolt x .98 [25] Long	2
13	WSH90166	Flat Washer, M6	2
14	SCR90877	M5 x 0.8 Pan Head Phillips Screw x .39 [10] Long	4
15	WSH90138	Lockwasher, M5	4
16	WSH90139	Flat Washer, M5	4
17	SCR90335	1/2 -13 x 1.0 Long Socket Cap Screw	4
18	GSK90161	Gasket, Case	1
19	GSK90155	Gasket, Flange	2
20	FLC90009	Flange, 2 FNPT	2
21	SCR90878	M6 x 1.0 Hex Head Bolt x 1.57 [40] Long	4
23	PLG90037	Plug, 1/4 NPT x .43 [11] Long	1
25	INS90020	Absorber	4
26	SCN90062	Screen	2
27	KEY90078	Key	1
28	SEL90104	Lip Seal	1
30	N/A	Impeller to case gap specification	N/A

VB030S, VB030

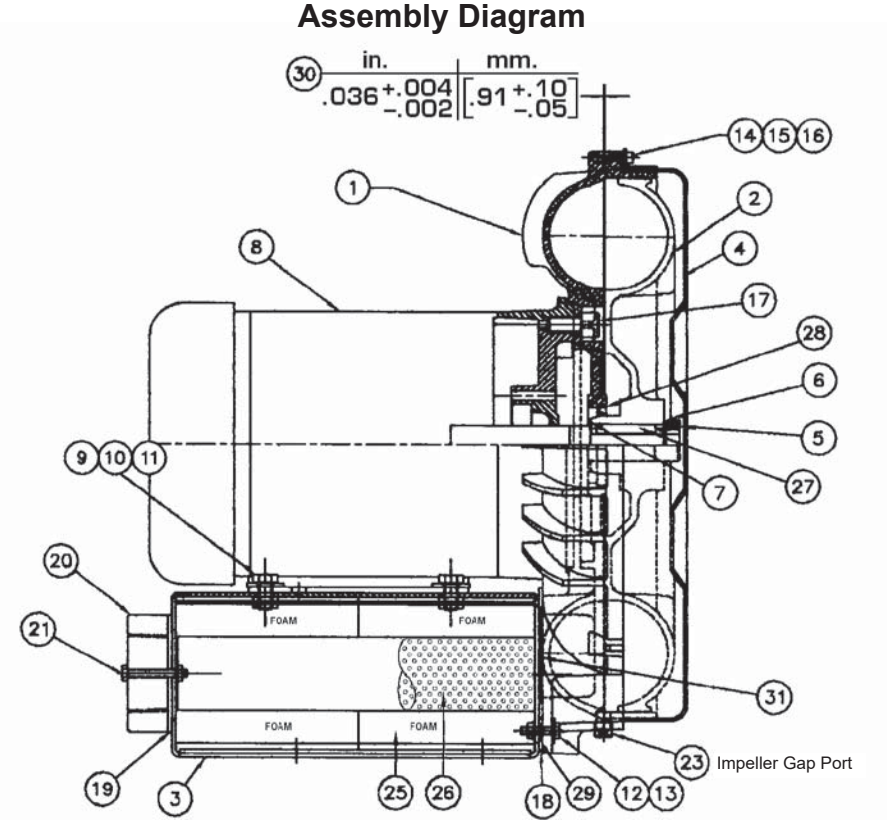
Performance Curves





Spencer® Vortex® Regenerative Blowers
VB037S, VB037, VB037XP

Assembly Diagram



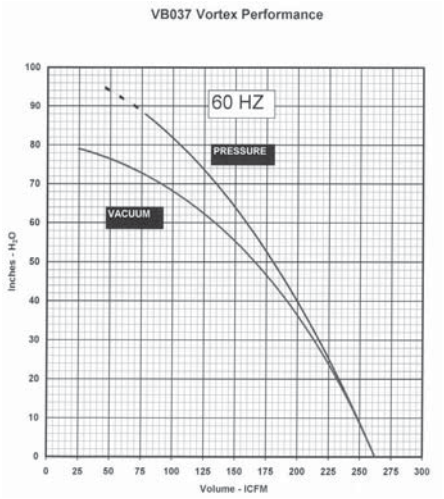
(See Bulletin 417, pages 40 and 41 for specifics on models with explosion-proof motors.)

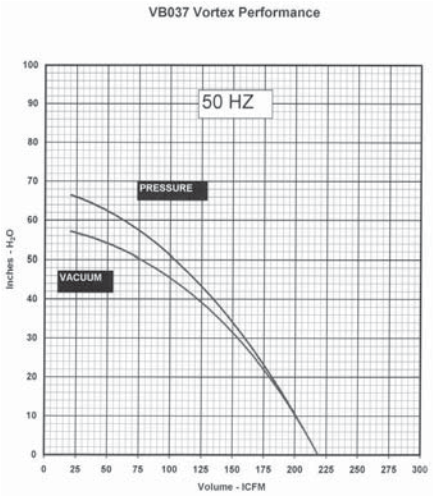
Parts List

DESCRIPTION: VORTEX BLOWER ASSEMBLY – VB037S, VB037, VB037XP			
ITEM	PART NO.	DESCRIPTION	QTY.
1	VBC93701	Case	1
2	VBI93702	Impeller	1
3	VBB93700	Base	1
4	VBE93701	Cover, Impeller	1
5	NUT90209	Locknut, Shaft	1
6	WSH90172	Lockwasher, Shaft	1
7	WSH90157	Shim, Shaft to Impeller (as required)	1
8	MOT90361	Motor, 184TC, 5 HP, 1PH, 50/60Hz	1
8A	MOT90181	Motor, 184TC, 5 HP, 3PH, 50/60Hz	1
8B	MOT90234	Motor, 184TC, 5 HP, 3PH, 575 Volt, 50/60Hz	1
8C	MOT90222	Motor, 184TC, 5 HP, 3PH, XP, 50/60Hz	1
8D	MOT90480	Motor, 184TC, 5 HP, 3PH, 60Hz	1
8E	MOT90479	Motor, 184TC, 5 HP, 1PH, 60Hz	1
9	SCR90879	M8 x 1.25 Hex Head Bolt x .98 [25] Long	4
10	WSH90148	Lockwash, M8	4
11	WSH90182	Flat Washer, M8	4
12	SCR90878	M6 x 1.0 Hex Head Bolt x 1.57 [40] Long	2
13	WSH90166	Flat Washer, M6	2
14	SCR90877	M5 x 0.8 Pan Head Phillips Screw x .39 [10] Long	4
15	WSH90138	Lockwasher, M5	4
16	WSH90139	Flat Washer, M5	4
17	SCR90335	1/2-13 x 1.0 Long Socket Cap Screw	4
18	GSK90154	Gasket, Case	1
19	GSK90155	Gasket, Flange	2
20	FLC90009	Flange, 2 FNPT	2
21	SCR90878	M6 x 1.0 Hex Head Bolt x 1.57 [40] Long	4
23	PLG90037	Plug, 1/4 NPT x .43 [11] Long	1
25	INS90021	Absorber	4
26	SCN90056	Absorber Screen	2
27	KEY90079	Key	1
28	SEL90104	Lip Seal	1
29	SPR90088	Spacer, Washer (Case to Base)	2
30	N/A	Impeller to case gap specification	N/A
31	PLC90027	Plate, Case	1

VB037S, VB037

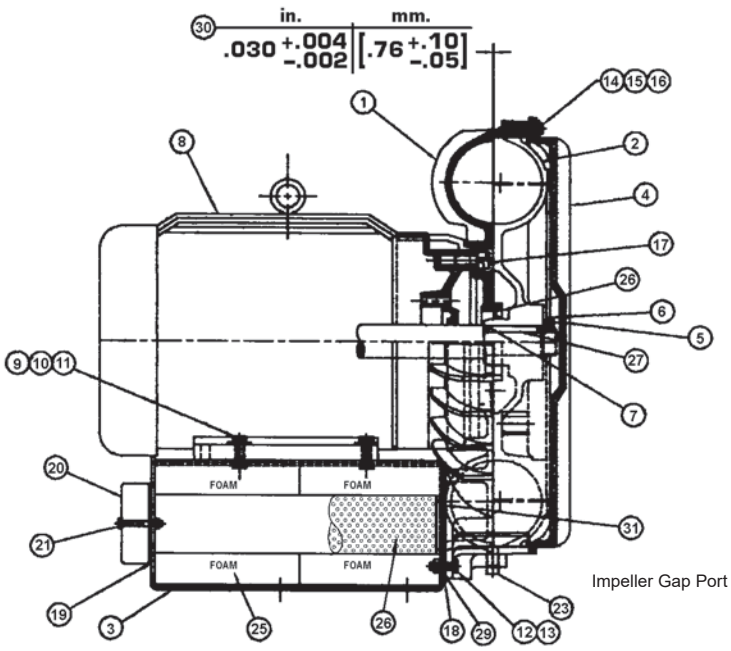
Performance Curves





Spencer® Vortex® Regenerative Blowers
VB055, VB055XP

Assembly Diagram



Impeller Gap Port

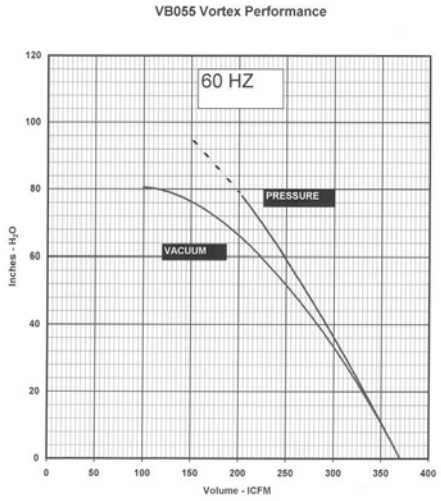
(See Bulletin 417, pages 42 and 43 for specifics on models with explosion-proof motors.)

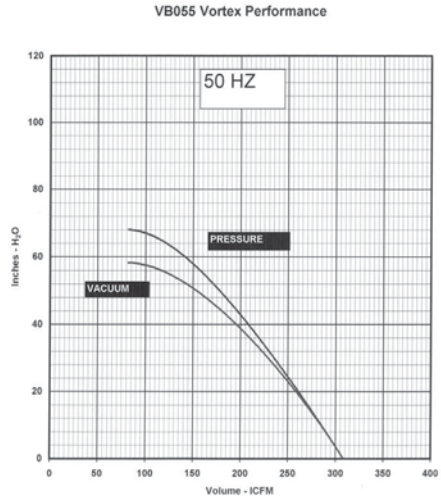
Parts List

DESCRIPTION: VORTEX BLOWER ASSEMBLY – VB055, VB055XP			
ITEM	PART NO.	DESCRIPTION	QTY.
1	VBC95501	Case	1
2	VBI95502	Impeller	1
3	VBB95501	Base	1
4	VBE95501	Cover, Impeller	1
5	NUT90211	Locknut, Shaft	1
6	WSH90173	Lockwasher, Shaft	1
7	WSH90154	Shim, Shaft to Impeller (as required)	1
8	MOT90182	Motor, 213TC, 7-1/2 HP, 3PH, 50/60Hz	1
8A	MOT90205	Motor, 213TC, 7-1/2 HP, 3PH, 575 Volt, 50/60Hz	1
8B	MOT90221	Motor, 213TC, 7-1/2 HP, 3PH, XP, 50/60Hz	1
8C	MOT90481	Motor, 213TC, 7-1/2 HP, 3PH, 60Hz	1
9	SCR90881	M8 x 1.25 Hex Head Bolt x 1.18 [30] Long	4
10	WSH90148	Lockwasher, M8	4
11	WSH90182	Flat Washer, M8	4
12	SCR90895	M8 x 1.25 Hex Head Bolt x 1.57 [40] Long	2
13	WSH90182	Flat Washer, M8	2
14	SCR90876	M6 x 1.0 Hex Head Screw x .98 [25] Long	8
15	WSH90143	Lockwasher, M6	8
16	WSH90142	Washer, Flat M6	8
17	SCR90335	1/2-13 x 1.0 Long Socket Cap Screw	4
18	GSK90156	Gasket, Case	1
19	GSK90157	Gasket, Flange	2
20	FLC90010	Flange, 2-1/2 FNPT	2
21	SCR90878	M6 x 1.0 Hex Head Bolt x 1.57 [40] Long	4
23	PLG90037	Plug, 1/4 NPT x .43 [11] Long	1
25	INS90022	Absorber	4
26	SCN90057	Absorber Screen	2
27	KEY90080	Key	1
28	SEL90105	Lip Seal	1
30	N/A	Impeller to case gap specification	N/A
31	PLC90028	Case Plate	1

VB055

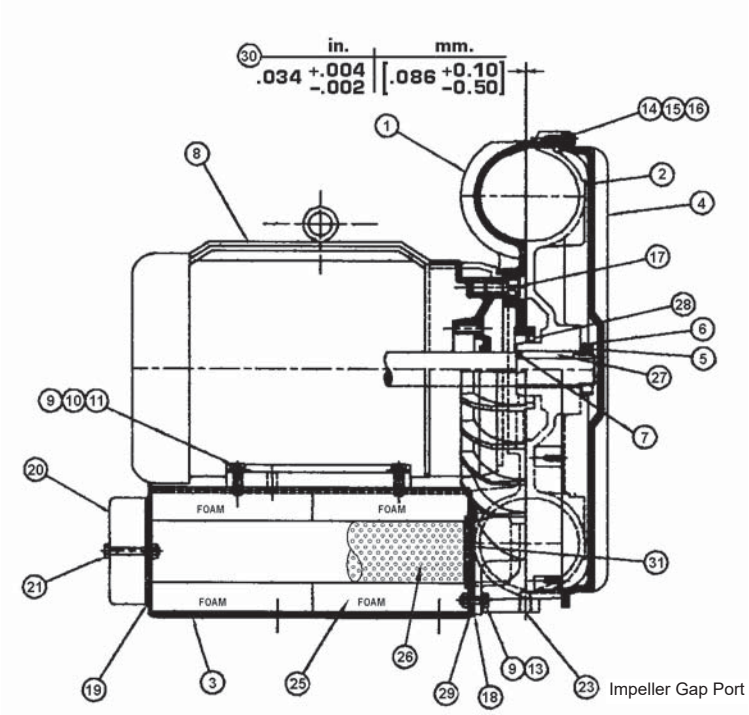
Performance Curves





Spencer® Vortex® Regenerative Blowers
VB075, VB075XP

Assembly Diagram



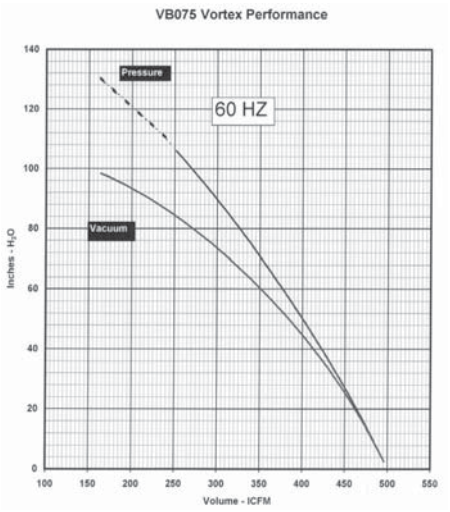
(Contact factory for specifics on models with explosion-proof motor.)

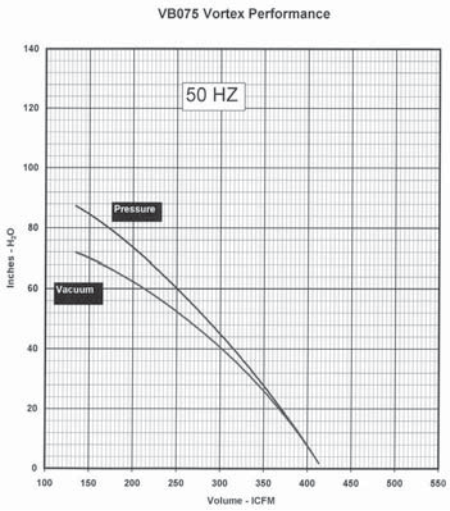
Parts List

DESCRIPTION: VORTEX BLOWER ASSEMBLY – VB075, VB075XP			
ITEM	PART NO.	DESCRIPTION	QTY.
1	VBC97501	Case	1
2	VBI97502	Impeller	1
3	VBB97501	Base	1
4	VBE97501	Cover, Impeller	1
5	NUT90213	Locknut, Shaft	1
6	WSH90174	Lockwasher, Shaft	1
7	WSH90179	Shim, Shaft to Impeller (as required)	1
8	MOT90199	Motor, 215TC, 10 HP, 3PH, 50/60Hz	1
8A	MOT90235	Motor, 215TC, 10 HP, 3PH, 575 Volt, 50/60Hz	1
8B	MOT90220	Motor, 215TC, 10 HP, 3PH, XP, 50/60Hz	1
8C	MOT90482	Motor, 215TC, 10 HP, 3PH, 60Hz	1
9	SCR90881	M8 x 1.25 Hex Head Bolt x 1.18 [30] Long	4
10	WSH90148	Lockwasher, M8	4
11	WSH90182	Flat Washer M8	4
12	SCR90881	M8 x 1.25 Hex Head Bolt x 1.18 [30] Long	2
13	WSH90182	Flat Washer M8	2
14	SCR90876	M6 x 1.0 Hex Head Screw x .98 [25] Long	8
15	WSH90143	Lockwasher, M6	8
16	WSH90142	Flat Washer M6	8
17	SCR90335	1/2-13 x 1.0 Long Socket Cap Screw	4
18	GSK90158	Gasket, Case	1
19	GSK90159	Gasket, Flange	2
20	FLC90011	Flange, 3 FNPT	2
21	SCR90883	M8 x 1.25 Hex Head Bolt x 2.165 [55] Long	4
23	PLG90037	Plug, 1/4 NPT x .43 [11] Long	1
25	INS90023	Absorber	4
26	SCN90058	Absorber Screen	2
27	KEY90081	Key	1
28	SEL90106	Lip Seal	1
29	SPR90089	Spacer, Washer (Case to Base)	2
30	N/A	Impeller to case gap specification	N/A
31	PLC90029	Case Plate	1

VB075

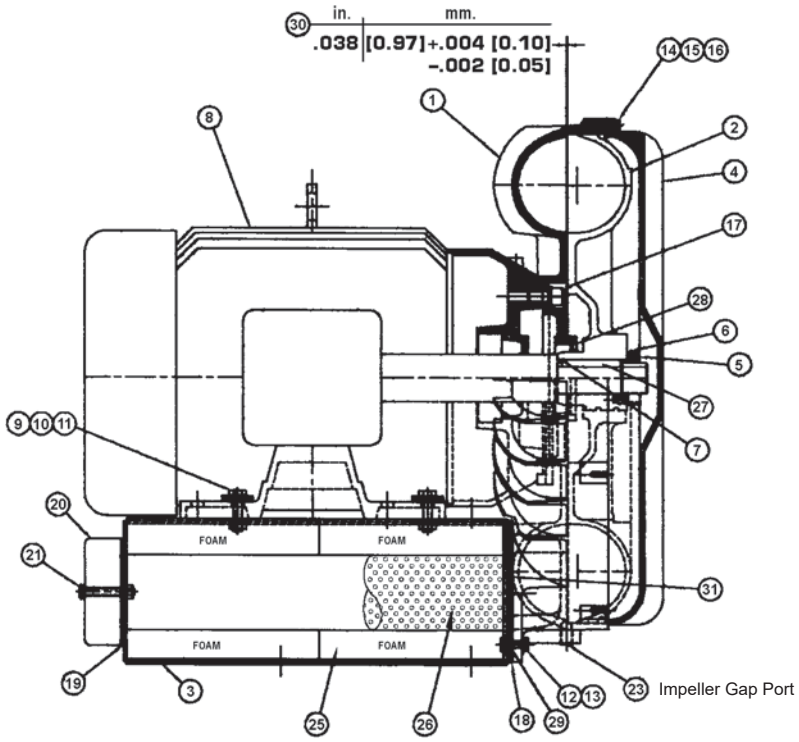
Performance Curves





Spencer® Vortex® Regenerative Blowers
VB110, VB110XP

Assembly Diagram



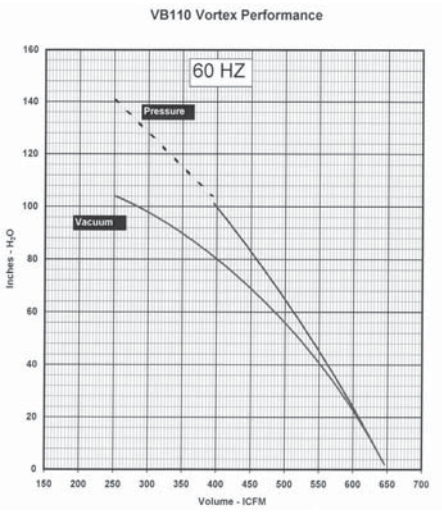
(Contact factory for specifics on models with explosion-proof motor.)

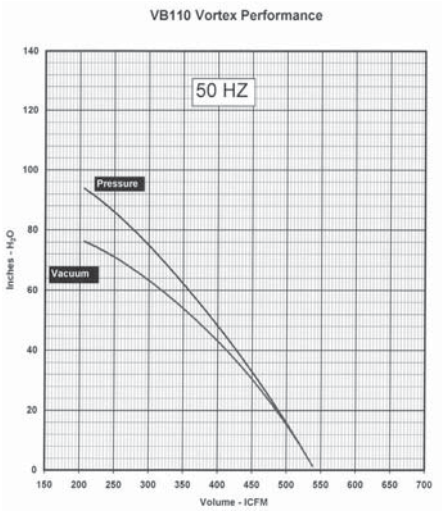
Parts List

DESCRIPTION: VORTEX BLOWER ASSEMBLY – VB110, VB110XP			
ITEM	PART NO.	DESCRIPTION	QTY.
1	VBC91101	Case	1
2	VBI91102	Impeller	1
3	VBB91101	Base	1
4	VBE91101	Cover, Impeller	1
5	NUT90213	Locknut, Shaft	1
6	WSH90174	Lockwasher, Shaft	1
7	WSH90179	Shim, Shaft to Impeller (as required)	1
8	MOT90200	Motor, 254-6TC, 15 HP, 3PH, 50/60Hz	1
8A	MOT90236	Motor, 254-6TC, 15 HP, 3PH, 575 Volt, 50/60Hz	1
8B	MOT90219	Motor, 254TC, 15 HP, 3PH, XP, 50/60Hz	1
8C	MOT90483	Motor, 254TC, 15 HP, 3PH, 60Hz	1
9	SCR90882	M10 x 1.5 Hex Head Bolt x 1.57 [40] Long	4
10	WSH90137	Lockwasher, M10	4
11	WSH90183	Flat Washer M10	4
12	SCR90881	M8 x 1.25 Hex Head Bolt x 1.18 [30] Long	2
13	WSH90182	Flat Washer M8	2
14	SCR90876	M6 x 1.0 Hex Head Screw x .98 [25] Long	8
15	WSH90143	Lockwasher, M6	8
16	WSH90142	Flat Washer M6	8
17	SCR90335	1/2-13 x 1.0 Long Socket Cap Screw	4
18	GSK90160	Gasket, Case	1
19	GSK90159	Gasket, Flange	2
20	FLC90011	Flange, 3 FNPT	2
21	SCR90883	M8 x 1.25 Hex Head Bolt x 2.16 [55] Long	4
23	PLG90037	Plug, 1/4 NPT x .43 [11] Long	1
25	INS90024	Absorber	4
26	SCN90061	Absorber Screen	2
27	KEY90082	Key	1
28	SEL90106	Lip Seal	1
29	SPR90089	Spacer, Washer (Case to Base)	2
30	N/A	Impeller to case gap specification	N/A
31	PLC90030	Case Plate	1

VB110

Performance Curves





VI. Troubleshooting Guide

Trouble	Possible Cause	Corrective Action
Blower Does Not Turn and there is -		
A Humming Sound	– One phase of power line disconnected	Connect power leads properly
	– One phase of stator line open	Contact factory
	– Bearing(s) defective	Change defective bearing(s)
	– Impeller jammed by foreign material	Clean impeller
	– Impeller jammed against casing or side cover	Adjust gap
	– Rubbing of rotor core and stator core	Contact factory
	– Capacitor open (single-phase models)	Change capacitor
No Sound	– Two phases of power line disconnected	Connect power leads properly
	– Two phases of stator winding open	Contact factory
	– Faulty switch connection	Change switch
	– Fuse blown	Change fuse
Blower Turns, but -		
Fuse Blows	– Fuse capacity insufficient, wiring fault	Inspect wiring
	– Short circuit	Repair
	– Terminals shorted	Improve insulation and check connections
	– Excessive load	Increase air flow
Overheats or Thermal Protector Activates	– Power source unbalance; possible voltage drop	Check voltage; phases must be balanced within 5% and voltage must be within 10% of rated
	– Operating in single-phase condition	Check connections
	– Excessive friction due to defective bearings	Replace bearings
	– Impeller contaminated by foreign material	Clean impeller
	– Impeller rubbing against casing or side cover	Adjust gap
	– Operation at less than minimum rated flow	Increase air flow
Makes Abnormal Sound	– Impeller rubbing against casing or side cover	Adjust gap
	– Impeller rubbed by foreign material	Clean impeller
	– Bearing(s) defective	Replace bearings
	– There is a leak or air passages are clogged	Repair or clean
	– Loose cap screw	Tighten screw

Customer Maintenance Log

DATE	PROCEDURE	COMMENTS	INITIALS

Spencer®

Products & Services

Industrially rated products offering effective solutions for air and gas handling problems:

- Multistage centrifugal blowers
- Single stage centrifugal blowers
- Gas boosters and hermetic gas boosters
- Regenerative blowers
- Modular central vacuum systems
- Mobile or stationary integrated vacuum units
- Separators and dust collectors
- Custom-engineered products with special materials for extreme temperatures and pressures

Complementary accessories with single source convenience and compatibility:

- Standard and custom electrical control panels – UL, CUL Listed and C.E. Compliant available
- Valves, gauges, couplings, shrink sleeves, vibration isolators and other system components
- Comprehensive selection of tubing, fittings, vacuum hoses, valves and tools

Comprehensive engineering and other customer support services:

- The industry's largest complement of technical specialists in air and gas handling technology
- Worldwide parts and service organization
- Application research and testing facility

Worldwide organization of sales representatives and distributors offering:

- Product selection, installation and operation assistance
- Comprehensive system design services
- Follow-up services and troubleshooting

For the name and telephone number of your local Spencer Representative, call 800-232-4321 or email marketing@spencer-air.com

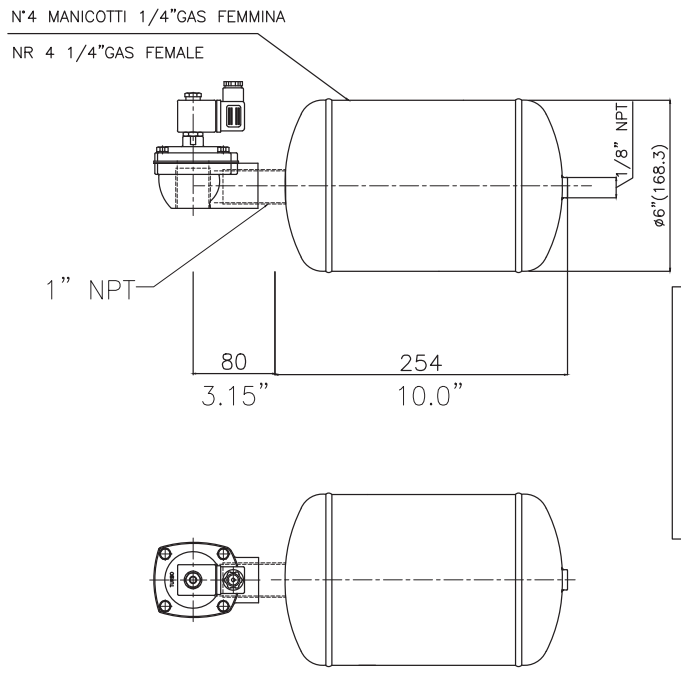
Blowers & Vacuum Systems with an Engineering Edge

The Spencer Turbine Company, 600 Day Hill Road, Windsor, CT 06095-4706

TEL 800-232-4321 ◆ 860-688-8361 ◆ FAX 860-688-0098 ◆ www.spencerturbine.com

SUFFIX	VOLTAGE	ROYAL #
01	24VDC	FP25/G NPT24
00	110VAC	FP25/G NPT110

LET	REVISION	DATE	DRAWN
A	ADD SUFFIX FOR 24VDC	4/15/13	EAD



VALVOLA DA 1" NPT
TUBO ACCIAIO INOX 304 SS
TRONCHETTO FILETTATO DA 1" NPT
MANICOTTO FILETTATO FEMMINA DA 3/8"NPT
TRATTAMENTO : (EXCEPT AS NOTED BELOW) MANDARE A LUCIDARE PRIMA DEL MONTAGGIO

HAPMAN CONVEYOR NOTES FROM ORIG QUOTE DATED OCTOBER 14, 2004:

304L STAINLESS

BRUSHED FINISH TANK WITH NON-ANODIZED (NO BLACK ANODIZATION) VALVE ON END

REVISIONE/REV	DATA/DATE	DESCRIZIONE MODIFICA/REVISION DESCRIPTION	DIS/DRAWN	CONTR/CHK	APPR/APPROVED

CODICE SERBATOIO/ TANK CODE TF6P25N1PxxxBG	VALVOLA/VALVE: FP25/G NPT[redacted]
CAPACITA'/LITRES: LT 6	COLORE/COLOUR: RAL NO
PRESSIONE DI ESERCIZIO/WORKING PRESSURE: 8 BAR MAX	WORKING TEMPERATURE: −10°C +55°C
TURBO srl VIA SAN CARLO 88 20031 CESANO MADERNO (MI) TEL.: ++39 0362 574024 FAX.: ++39 0362 574092 e-mail: turbocontrols@tin.it www.turbocontrols.it	CLIENTE/CUSTOMER: ROYAL/HAPMAN RIF.CLIENTE/REFERENCE DISEGNO/DWG: DP3699A
DISEGNATO DRAWN: MF CONTROLLATO CHECKED APPROVATO APPROVED DATA/DATE SCALA/SCALE	REVISIONE REVISION

Q:STDHAP\PNEU\09155010.DWG

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE ENGLISH (FEET AND/OR INCHES)
TOLERANCES

DECIMALS	INCHES	FEET	ANGLES
.X ±.030 .XX ±.015 .XXX ±.005	X"= ±1/16"	X'−X"=±1/4" UP TO 20 FEET X'−X"=±1/2" OVER 20 FEET	±1°

DO NOT SCALE DWG.
BREAK ALL SHARP EDGES

MATERIAL: 304L SS

FINISH: BRUSH FINISH

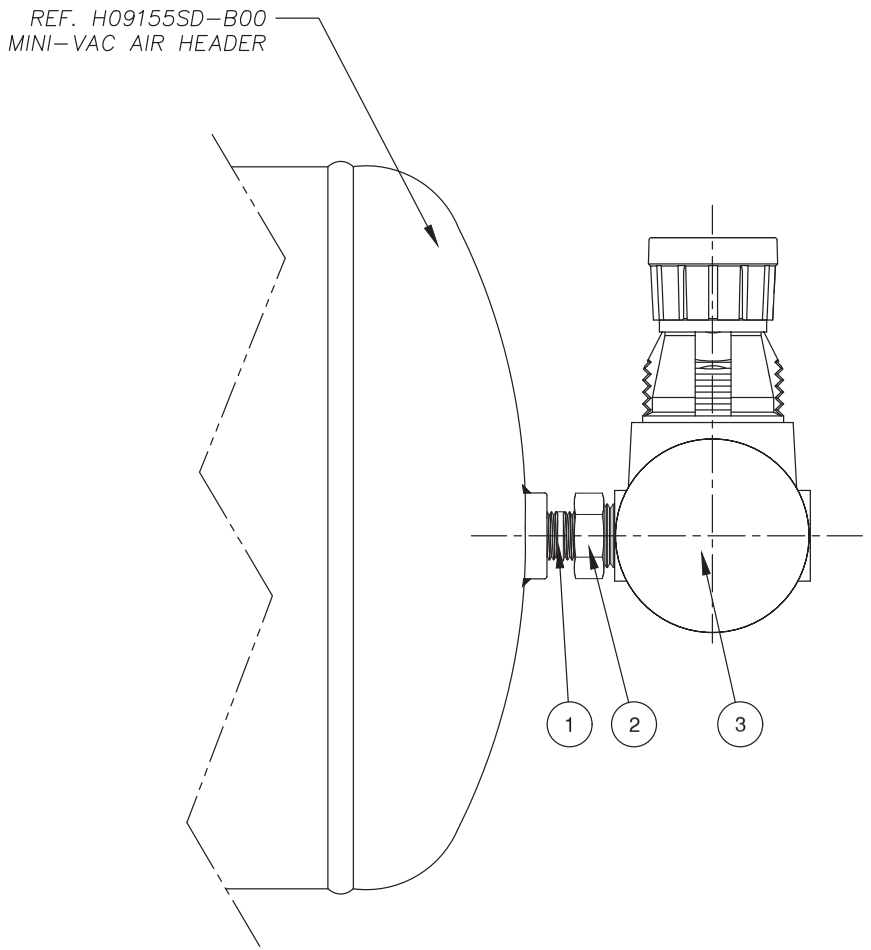
HAPMAN

Hapman Conveyors
6002 EAST KILGORE ROAD
KALAMAZOO, MICHIGAN 49003
AREA CODE 616/343-1675
TEXEX 224468

NAME: AIR HEADER, 6" DIA X 10" LG W/VALVE 304L SS

DRAWN	DATE	SCALE	REV. DATE
MH	1/10/05	2"=1"	4/15/13

SHEET OF	DWG. NO.	REV.
1 1	H09155SD−B__	A



	REV.	SUF.	ITEM NO.	DRAWING/PART NO.	DESCRIPTION	QTY	UOM
B00	A		1		CLOSE NIPPLE- 1/8 NPT, PLATED	1	--
	A		2		REDUCING HEX- 1/4 NPT TO 1/8 NPT, PLATED	1	--
			3	14R116FC	REGULATOR W/GAUGE, 0-60 PSI, 1/4 NPT	1	--
							--
B01	A		1		CLOSE NIPPLE- 1/8 NPT, S.S.	1	--
	A		2		REDUCING HEX- 1/4 NPT TO 1/8 NPT, S.S.	1	--
			3	14R116FC	REGULATOR W/GAUGE, 0-60 PSI, 1/4 NPT	1	--

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE ENGLISH (FEET AND/OR INCHES)

TOLERANCES

DECIMALS	INCHES	FEET	ANGLES
.X ±.030" .XX ±.015" .XXX ±.005"	X"= ±1/16"	X'-X"=±1/4"UP TO 20 FEET X'-X"=±1/2" OVER 20 FEET	±1°

DO NOT SCALE DRAWING | REMOVE ALL SHARP EDGES

REV	REVISION DESCRIPTION	DATE	BY
A	SEPERATED THE BOM BY THE ASSEMBLY SUFFIX NUMBER	4/30/13	CJC

HAPMAN
Ideas that move
P.O. BOX 2321
6002 E. KILGORE ROAD, KALAMAZOO, MICHIGAN 49048
PHONE (269) 343-1675 FAX (269) 349-2477

DATE	8/25/11	JOB NO.	DRAWN E. DZIERFZYC
SCALE	NONE		BOM = 0 DWG = 1

Q:\HAPMAN\LIBRARY\9535B

TITLE

REGULATOR ASSEMBLY FOR MINI-VAC AIR HEADER

CUST.

SHEET	OF	DWG. NO.	REV.
1	1	9535-B__	A

SUFFEX	MATERIAL OF CONSTRUCTION
01	304 STAINLESS STEEL CONSTRUCTION
00	CARBON STEEL CONSTRUCTION

LET	REVISION	DATE	DRAWN
A	UPDATED VENDOR DATA	11/05/07	MAV
B	REMOVED VENDOR SPECIFIC INFORMATION	01/21/16	JAF

FILTER 7.875 O.D X 3.56" I.D X 16"Lg.
STAINLESS STEEL END CAPS
GALVANIZED INNER CORE
MEDIA- "PTFE POLYESTER"/16OZ. POLYESTER FELT
FILTER AREA - 13 SQ FT.
NO OF PLEATS - 30
POTTING - WHITE FOOD GRADE SILICONE
GASKET - WHITE SILICONE
FDA APPROVED MATERIALS
OPEN TOP, CLOSED BOTTOM WITH 9/16" HOLE
MAXIMUM OPERATING TEMP - 240° F
MAXIMUM OPERATING DIFFERENTIAL PRESSURE - 25" WG
TYPICAL USES - BAG DUMP DUST COLLECTOR, MODEL 20 PNEU.
RECEIVERS

HAPMAN
ideas that move
P.O. BOX 2321
6002 E. KILGORE ROAD, KALAMAZOO, MICHIGAN 49048
PHONE (269) 343-1675 FAX (269) 349-2477

NAME
AIR FILTRATION CARTRIDGE

DRAWN	DATE	SCALE
DRB	3/16/93	NONE

DWG. NO.
104909-B

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Description

When it comes to machine safety, Rockwell Automation knows that protection of personnel and equipment is your main concern. At the same time, flexibility and productivity are points that must also be considered as you design your safety system. Optimize all of these with the new Allen-Bradley SensaGuard family of noncontact switches.

Featuring the latest generation of RFID technology for coding and Inductive technology for sensing, SensaGuard's large sensing range and tolerance to misalignment is a cost-effective solution that is ideally suited for a wide range of industrial safety applications.

The SensaGuard product line is a Category 4 /SIL 3 rated switch per EN954-1, TÜV functional safety approved to IEC 61508.

Features

- Switches can be connect to a standard safety relay, for example, the MSR126, MSR127, MSR200/300 Family, SmartGuard and Safety I/O Blocks
- Multiple actuator sizes for large sensing distance
- IP 69K environmental rating
- Short-circuit and over-voltage protection
- Led located on the switch for door status and troubleshooting

Benefits

- No dedicated controller required
- Cat 4/SIL 3 rating maintained even with multiple units connected in series
- Switches can be connected in series with other devices (light curtain, E-stops, key interlock switches)
- Extended diagnostics for easy troubleshooting
- Large sensing distances
- Tolerance to misalignment
- Multiple sensing directions
- Stainless steel version suitable for use in harsh environments
- Use standard proximity brackets

Specifications

Category	Cat. 4/SIL3		
Certifications	TÜV, CE, cULus (UL 508)		
Standards	IEC 60947-5-3, IEC 61508, EN 954		
PFHd	1.119...10^{-9}		
Operating Characteristics			
Sensing Distance (Target)	**18 mm Plastic**	**30 mm Plastic**	**18 mm SS**
Operating Distance, Make—mm (in)	Assured: 15 (0.59)	Assured: 25 (0.98)	Assured: 10 (0.39)
Case Material	Valox® DR 48		304 Stainless Steel
Actuator Material	Valox® DR 48		304 Stainless Steel
Typical Misalignment	See misalignment curve.		
Repeat Accuracy	10% of Sensing Range		
Output Current, Max.	200 mA (all outputs)		
Switching Current @ Voltage, Max.	24V DC +10%/-15%		
Operating Voltage/Supply Current	24V DC, +10%/-15% Class 2 SELV power supply		
Frequency of Operating Cycle	1 Hz		
Response Time (Off)	54 ms		
Outputs (Guard Door Closed, Actuator in Place)			
Safety Outputs	2 x PNP, 0.2 A, max.; Status: ON (+24V DC)		
Auxiliary Outputs	1 x PNP, 0.2 A max.; Status: OFF (0V DC)		
Environmental			
Operating Temperature—C (F)	-10...+55° (+14...+131°)		
Relative Humidity	5...95%		
Enclosure Type Rating	NEMA 3, 4X, 12, 13, IP 69K		
Shock	IEC68-2-27 30 g, 11 ms		
Vibration	IEC 68-2-6 10...55 Hz		
Radio Frequency	IEC 61000-4-3, IEC 61000-4-6		
Protection			
Protection Type	Short Circuit, Current Limitation, Overload, False Pulse, Transient Noise, Reverse Polarity, Overvoltage (inc. load dump), Thermal Shutdown with restart, Loss of GND and Vdd		
Loss of GND and Vdd protection	Incorporated		
Electrical Life	10 x 10^6		

Noncontact Switches

SensaGuard™ 18 mm Barrel

Product Selection

Description	Operating Voltage/ Input Current	Safety Outputs	Auxiliary Outputs	Actuator Type	Assured Sensing Distance	Connection	Cat. No.
18 mm Plastic Barrel	24V DC, +10%/-15%/ 50 mA max.	2 Solid State outputs	1 Solid State output	18 mm	15 mm (0.59 in)	6 in Pigtail, 8-Pin Micro (M12)	440N-Z21S16H
						3 m Cable	440N-Z21S16A
						10 m Cable	440N-Z21S16B
				30 mm	25 mm (0.98 in)	6 in Pigtail, 8-Pin Micro (M12)	440N-Z21S26H
						3 m Cable	440N-Z21S26A
						10 m Cable	440N-Z21S26B
18 mm Stainless Steel Barrel				18 mm	10 mm (0.39 in)	6 in Pigtail, 8-Pin Micro (M12)	440N-Z21S17H
						3 m Cable	440N-Z21S17A
						10 m Cable	440N-Z21S17B

Recommended Logic Interfaces

Description	Safety Outputs	Auxiliary Outputs	Terminals	Reset Type	Power Supply	Cat. Pg. No.	Cat. No.
Single-Function Safety Relays							
MSR127RP	3 N.O.	1 N.C.	Removable Screw	Monitored Manual	24V AC/DC	—	440R-N23135
MSR127TP	3 N.O.	1 N.C.	Removable Screw	Automatic/Manual	24V AC/DC	—	440R-N23132
Modular Safety Relays							
MSR211P Base 2 N.C. only	2 N.O.	1 N.C. and 2 PNP Solid State	Removable	Automatic/Manual Monitored Manual	24V DC	—	440R-H23176
MSR220P Input Module	—	—	Removable	—	24V DC	—	440R-H23178
MSR310P Base	—	3 PNP Solid State	Removable	Automatic/Manual Monitored Manual	24V DC	—	440R-W23219
MSR320P Input Module	—	2 PNP Solid State	Removable	—	24V DC	—	440R-W23218

Note: For additional Safety Relays connectivity, see the Logic section of this catalog.
For additional Safety I/O connectivity, see the Safety I/O section of this catalog.
For Application and wiring diagrams, see the Applications section of this catalog.

Connection Systems

Description	Cat. No.
Cordset	889D-F8AB-*

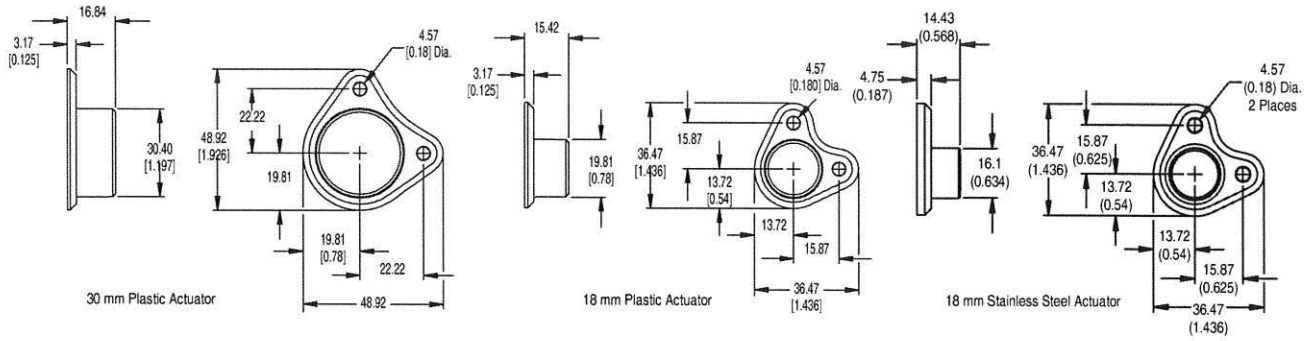
* Replace symbol with 2 (2 m), 5 (5 m), or 10 (10 m) for standard cable lengths.

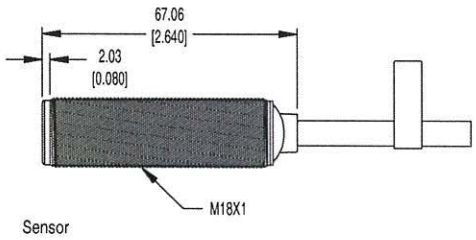
Accessories

	Description	Dimensions	Cat. No.
	18 mm Plastic Actuator	—	440N-Z18PT
	30 mm Plastic Actuator	—	440N-Z30PT
	18 mm Stainless Steel Actuator	—	440N-Z18SST
	Mounting Bracket for Tubular Sensors—Right Angle Style	—	871A-BRS18
	Mounting Bracket for Tubular Sensors—Clamp Style	—	871A-BP18
	Snap Clamp Mounting Bracket	—	871A-SCBP18
	Swivel/Tilt bracket allows ±10° vertical and 360° rotation adjustment.	—	60-2649

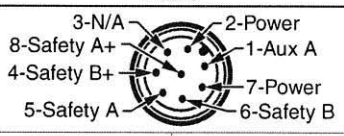
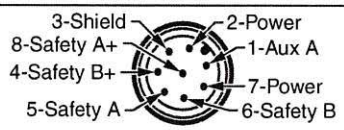
Approximate Dimensions—mm (inches)

Dimensions are not intended to be used for installation purposes.





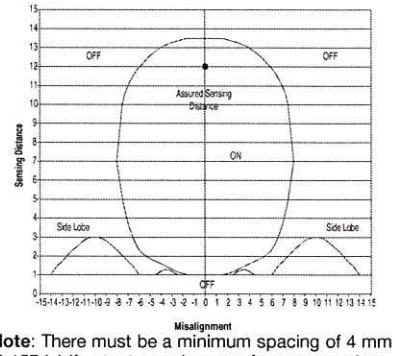
Typical Wiring Diagrams

Description		Plastic		Stainless Steel	
8-Pin Micro (M12)					
8-Pin Cordset 889D-F8AB-*	Grey	OSSD 1	Safety A	OSSD 1	Safety A
	Red	OSSD 1+		OSSD 1+	
	Pink	OSSD 2	Safety B	OSSD 2	Safety B
	Yellow	OSSD 2+		OSSD 2+	
	White	Aux A		Aux A	
	Brown	24V DC	Unit Power	24V DC	Unit Power
	Blue	Gnd		Gnd	
	Green	NA		Shield	

* Replace symbol with 2 (2 m), 5 (5 m) or 10 (10 m) for standard cable lengths.

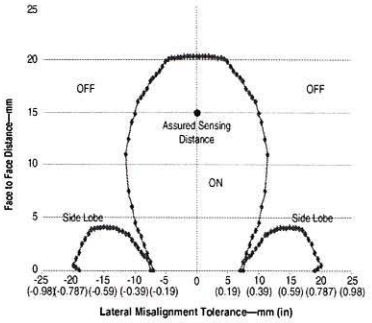
Misalignment Curve

18 mm Stainless Steel Barrel



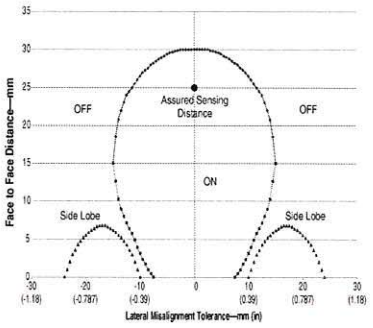
Note: There must be a minimum spacing of 4 mm (0.157 in) if actuator and sensor face approaches laterally. This will prevent false triggering due to the side lobe areas.

18 mm Plastic Barrel



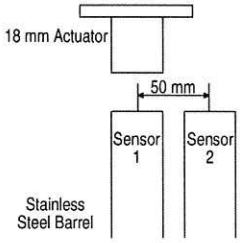
Note: There must be a minimum spacing of 4 mm (0.157 in) if actuator and sensor face approaches laterally. This will prevent false triggering due to the side lobe areas.

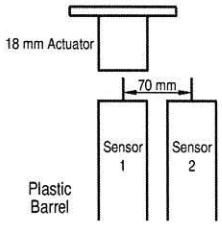
30 mm Plastic Barrel

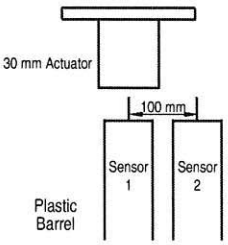


Note: There must be a minimum spacing of 7 mm (0.275 in) if actuator and sensor face approaches laterally. This will prevent false triggering due to the side lobe areas.

Minimum Distance Between Sensors







Diagnostic

Unit Indicators (per IEC 60073)

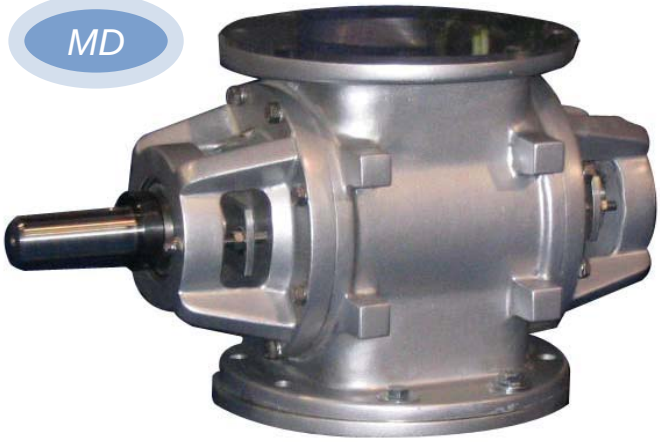
	State	Status	Troubleshooting
Device Output LED	Off	Not Powered	NA
	Red	Not Safe, OSSD Not Active	NA
	Green	Safe, OSSD Active	NA
	Green Flash	Power Up Test or OSSD Inputs Not Valid	Check 24V DC on OSSD Inputs (yellow and red wire)
	Red Flash	1 Hz Flash Recoverable Fault 4 Hz Flash Nonrecoverable Fault	Recoverable Fault: Check OSSD Outputs Are Not Shorted to GND, 24V DC or Each Other. Cycle Power.

ACS VALVES

EQUIPMENT INSTRUCTION MANUAL
ACS Rotary Airlock Valve/Feeders

DR-S

MD



CI

Heavy Duty Extra Tough

611 Argyle St. N. Caledonia, Ontario N3W 1M1 TEL: (800) 655-3447 FAX: (800) 955-4991
Email: sales@acsvalves.com Website: www.acsvalves.com

ACS VALVES
ANCASTER CONVEYING SYSTEMS

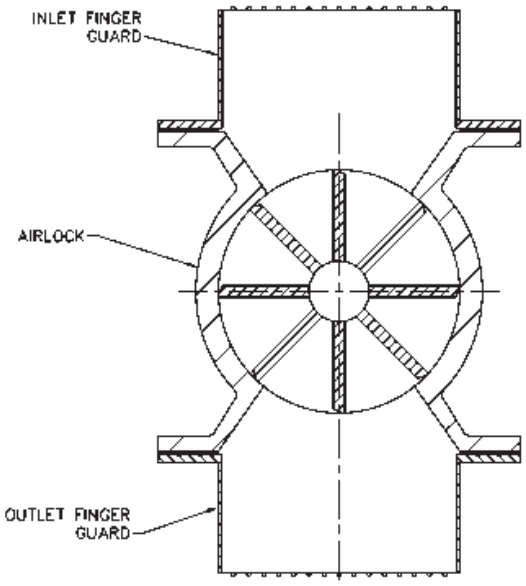
611 Argyle St. N. Caledonia, Ontario N3W 1M1 TEL: (800) 655-3447 FAX: (800) 955-4991
Email: sales@acsvalves.com Website: www.acsvalves.com

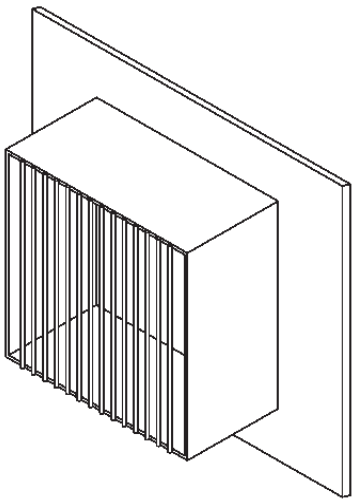
SAFETY FIRST

WARNING/CAUTION

DO NOT INSTALL ROTARY AIRLOCK VALVES & FEEDERS IN AN APPLICATION, WHICH LEAVES THE INLET OR THE OUTLET FLANGE OPENING EXPOSED.

INLET & OUTLET FLANGE GUARDS ARE MANDATORY IF EITHER THE INLET OR OUTLET FLANGES ARE EXPOSED.
THESE FLANGE GUARDS ARE AVAILABLE APON REQUEST





611 Argyle St. N. Caledonia, Ontario N3W 1M1 **TEL: (800) 655-3447** **FAX: (800) 955-4991**
Email: sales@acsvalves.com **Website:** www.acsvalves.com

Congratulations on your selection of an **"ACS"** Rotary airlock. The unit will require very little attention to keep it in good operating condition.

Safety Precautions

This Safety alert symbol is used to call your attention to an important safety message on equipment, safety decals and in manuals, to warn you of possible danger to your personal safety. When you see this symbol, be alert; your personal safety or the safety of the other persons is involved. Follow the instructions in the safety message.

The following definitions for identifying hazard levels are:

DANGER (RED) **–** Danger is used to indicate the presence of a hazard that WILL cause SEVERE personal injury, death, or substantial property damage of the warning is ignored.

WARNING (ORANGE) – Warning is used to indicate the presence of a hazard that CAN cause SEVERE personal injury, death, or substantial property damage if the warning is ignored.

CAUTION (YELLOW) – Caution is used to indicate the presence of a hazard that WILL or CAN cause MINOR personal injury or property damage if the warning is ignored.

WARNING: All owners and operators should read this manual, or be instructed in safe operating and maintenance procedures, before attempting to uncrate, install, operate, adjusts, or service this equipment.

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RECEIVING YOUR AIRLOCK

As soon as the equipment is received, it should be carefully inspected to make certain the unit is in good condition and all items listed on the packing list are received. Even though the equipment is mounted on heavy shipping skids at our plant, it is possible for it to be damaged in shipment. All damages or shortages should be noted on the Bill of Lading. Purchaser should take immediate steps to file reports and damage claims with the carrier. All damages incurred to the units in transit are the responsibilities of the common carrier since it is the manufacturer's policy to make shipment F.O.B. its factory: i.e., Ownership passes to purchaser when the unit is loaded and accepted by trucker. Any claims for in transit damage or shortage must be brought against the carrier by the Purchaser.

If the unit is not going to be installed soon after arrival, it should be stored in a warm, dry location to protect from corrosion to the machined surfaces.

CAUTION: Read All Instructions contained in this manual before installing and operating this equipment.

WARNING

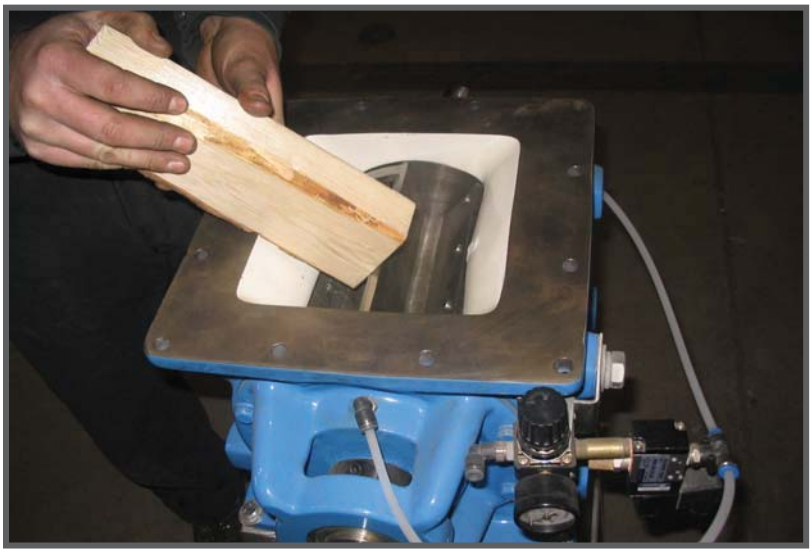

FIGURE 1

ONCE PROTECTIVE FLANGE COVER IS REMOVED FROM VALVE, DO NOT PLACE HANDS OR FEET IN THE VALVE OR ATTEMPT TO TURN ROTOR ASSEMBLY BY HAND. TO TEST ROTATE THE ROTOR, USE A SOFT PUSH BAR (2 x 4) AS SHOWN IN FIGURE 1. WE RECOMMEND ALL OWNERS AND/OR OPERATORS OF THIS EQUIPMENT READ THIS MANUAL. FOLLOW SAFE OPERATING & MAINTENANCE PROCEDURES. SAFETY COMES FIRST!

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OPERATING INSTRUCTIONS FOR ACS ROTARY AIRLOCK PACKAGE

Rotary Airlocks

The Rotary Airlock is one of the most important units in your material handling system. The function of the airlock is to hold pressure or vacuum in a pneumatic system, and also to meter products into conveying lines, or storage areas, (bins, tanks, hopper, etc.)

The airlock operates by filling each rotor pocket with material at the high point of rotation and then empties into conveying lines or storage areas at the low point of rotation.

In the case of conveying line, a blow-thru is used to allow the velocity of the air to move the material through the conveying line. After each rotor pocket has emptied into the blow-thru it still contains pressurized air. With some products, this air is allowed to escape up through the bulk material as soon as the edge of the rotor blade passes the edge of the inlet opening. The release of this pressurized air assists in maintaining a continuous flow of product to the airlock inlet. With some products, this air must be vented to atmosphere or to a dust collector, as it tends to hinder rather than help the flow of material into the airlock.
*The above procedure is endlessly repeated to produce a continuous flow of material at the discharge end of the conveying line.

The airlock rotor is precision machined to obtain the desired high degree of accuracy and close tolerance. Rotors may be supplied either with fixed or adjustable tips.

The airlock rotor is mounted on bearings at each end of the rotor shaft. Rotor clearance is small to prevent excessive air leakage back to the product inlet.

Installation of Airlock Packages

After airlock packages are uncrated, disconnect the chain drive and rotate the airlock with a soft push bar, the rotor should be able to rotate freely without binding.

Check clearance between rotor tips and valve housing. Clearance should not be greater than that specified on the invoice. If adjustable tips are provided and have shifted out of adjustment during shipping, re-adjust as per instructions found in maintenance section of this manual.

If airlock clearances and rotations are correct, replace chain drive, position an anchor package.

See Figure 1

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Numerous types of bulk materials feeding devices can be connected to the inlet opening of an airlock. Bins, hoppers, mixers, sifters, screw conveyors, etc. all can be adapted for attachment to the airlock. In all cases, except sifters, rigidly attach the feeding device to the airlock flange, using silicone caulk to obtain an air-tight connection. Be sure all seams in the feeding device are air-tight.

If the airlock package is to be hung from a hopper, storage tank, etc. it may be necessary for some type of structural steel support. However, in most cases, the hopper or tank flange will have sufficient strength to support the weight of the airlock package.

Normally, it is not good practice to use the airlock to support equipment loads either in compression on the top flange or in tension from the bottom flange. Excessive loads will cause the housing to distort, which will result in the loss of precise clearances. Loss of clearance between the rotor and housing can result in excessive noise, binding and galling.

Flanges of components, which attach to the airlock must be flat and "square" with the airlock flanges. The machines flanges of cast airlock housing must not be forced or conform to warped or twisted fabricated flanges. This practice can result in broken airlock housing or loss of clearance as noted above.

If the airlock is to be installed with either the **inlet or discharge exposed, a guard must be mounted to the appropriate flange** in order to reduce the risk of personal injury to operators, maintenance personnel, or others who may be near the equipment. Any object placed in the inlet area or discharge area of the airlock will be sheared off. Inlet and discharge guards are available from **Ancaster Conveying Systems**.

Air Purge Kit - Optional

The optional air Purge Kit may be used to provide compressed air the shaft seal area on airlocks with either open or closed end rotors. This kit may also be used to provide compressed air to the end plate cavity on the airlocks with closed end rotors.

The Air Purge Kit should included a Filter/Regulator, 0-30 psi pressure gauge, tubing and miscellaneous fittings. Depending on the airlock model and what ports are to be purged, certain fittings supplied in the kit may not be required.

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Air Purge Pressure Adjustment

Shut off the compressed air supply and bleed off air pressure before attempting to install or service the air purge assembly.

After installation is complete and while the filter/regulator is shut off completely, the air supply should be turned on.

After verifying that all connections are tight the regulator should be adjusted to provide the appropriate purge pressure to the airlock using the following guidelines.

1. Initial setting, prior to conveying product through the airlock or system should be 5 psig.
2. If the airlock is either receiving product from or discharging product to a pressure system the regulator should be set at 5 psig above the system conveying pressure.
3. If the airlock is used in a gravity flow application or is receiving or discharging only to a vacuum system the regulator should remain set at 5 psig.

Air Purge Assembly For Airlocks
With Open or Closed End Rotors

ITEM	P/N	QTY	DESCRIPTION
1	128961	1	Filter/Regulator with gauge & bracket
2	128937	1	3/8” Male Branch Tee Poly-Flo fitting
3	128929	4 ft.	3/8” O.D. Nylo-Seal Tubing
*4	120022	2	3/8” Poly-flo to 1/8” MNPT Connector
5	112895	1	0-30 PSI, 2” Face, ¼” CTR Back Gauge
°6	128945	2	3/8” Poly-flo to 3/8” MNPT Connector
°7	102733	2	3/8” Poly-Flo Union Tee
°8	125539	2	¾ x 3/8 Hex Bushing
	400726	1	Air Purge Kit (includes items 1 thru 8)

Please Note: *** Fittings for purging shaft seal**
° Fittings for purging end plate cavity

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Airlock Maintenance And Adjustment

Airlock maintenance is just as important as the unit is to the system. Type "CI" airlocks are assembled with sealed bearings, therefore requiring no lubrication.

Blade clearance should be checked as part of the maintenance program. Blade clearance should be within the allowable clearance range of the appropriate service. (See table). Each airlock is built to a standard, which is determined by its size and design operating conditions. The appropriate standard established for any airlock can be determined by checking the order acknowledgement.

Fixed tip airlocks obviously have no adjustment at tips, but should be checked to determine if the airlock is functioning in the system properly. Airlocks equipped with adjustable tips have a definite advantage. If clearances do not fall within rotor clearance range for the airlock, the tips can easily be adjusted. Adjusting tips of an airlock should be done as follows after electrical power is turned off.

Disconnect all electrical power to airlock before performing any maintenance.

1. Disconnect drive chain.
2. Access through either inlet or outlet.
3. Mark blades one through eight (assuming it is an 8-vane rotor).
4. Loosen bolts on number one blade.
5. Using two feeler gauges, insert between blade and housing, one at each end.
6. Push blade up tight against feeler gauges and tighten bolts.
7. Rotate blade and measure clearance on both sides of housing. This will determine which is tight side of housing.
8. Repeat steps 4, 5, &6 on all blades settings them against tight side of housing.

NOTE: As each blade is adjusted, make sure clearance is held uniformly by spinning rotor 360 degrees after completing steps 4, 5 & 6, and also by re-measuring with feeler gauge.

Disassembly of an airlock can be done quickly and efficiently by following the proper procedures.

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Remove Rotor:

1. Determine which side rotor is to be pulled from. Normally clearance permitting, drive side is pulled to avoid dismantling of sprocket and re-alignment.
2. Disconnect drive chain
3. Loosen and remove bearing lock-collar at bearing opposite the drive side.
    a) Remove allen set screw from collar and peen down groove formed by set screw using a small flat punch.
    b) Loosen collar by rotating collar in the same direction as the shaft rotation. Use drift pin in the plain hole (not threaded set screw hole) and tap with hammer to rotate collar.
    c) Slide collar off shaft.
4. Airlocks with packing gland seals, loosen the packing gland bolts (2 ea.) opposite the drive side.
5. On type “CI” Airlocks loosen the shaft seal collar, located within the end plate bearing port.
6. Remove the bolts on end cover (side to be pulled).
7. On all models place wheel puller at end opposite the drive end, hooking it at back of bearing port. Place puller bolt at the shaft and push rotor through until it slides freely.
8. Remove rotor from housing gently to keep from forming burrs on rotor or housing.

Replacing Rotor

1. Carefully check to see if rotor or housing have burrs. (Blade tips, shrouds, and housing matching surfaces). If burrs are found, file them smooth using a fine file and then polish with emery paper.
2. Check rotor shaft, file and sue emery paper on any rough surface found.
3. Blow off rotor and shaft to clean any foreign material. Also check end cover to see that matching edges to housing are clean.
4. Gently slide rotor into housing. Rotor normally will not slide the last few inches easily. Use a large rubber hammer to pound rotor far enough to start end cover bolts, and tighten evenly.
5. Make sure rotor is centred in housing. If not, loosen bearing lock collars, and centre with rubber mallet by tapping end of shaft.
6. Tighten bearing lock collars in the direction opposite to shaft rotation.
7. Tighten packing gland bolts evenly or tighten shaft seal collar.
   Note: If rotor does not turn freely, loosen end cover bolts. Centre rotor with feeler gauges and retighten bolts evenly.
8. Turn rotor by hand. Check clearances and see that rotor turns freely in housing.

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Removing End Covers

1. Remove bolts that attach end cover to housing
2. Loosen and remove bearing lock collar
   a) Remove allen set screw from collar and peen down groove formed by set screw using a small flat punch.
   b) Loosen collar by rotating collar in direction opposite shaft rotation. Use drift pin in the plain hole (not threaded set screw hole) and tap with hammer to rotate collar.
   c) Slide collar off shaft.
3. Loosen packing gland bolts or shaft seal collar, if applicable.
4. Attach wheel puller.
5. Tighten slowly until cover slides off shaft. If cover tends to bind on shaft, tap puller bolt with rubber mallet as you tighten.

Remove Press-Fit Bearings

1. Remove end cover.
2. Press bearing in the appropriate direction to remove from end plate.

Replacing Press-Fit Bearings

1. Align bearing with machined hole in end cover.
2. Be sure the eccentrically machined end of the inner bearing ring will be at the outer face of the endplate so that matching bearing lock collar can be properly installed.
3. Press the bearing in place.

Installing Press-Fit Bearing Lock Collar

1. Check to see that bearing has been pressed into endplate with eccentrically machined face of inner bearing ring facing outward toward the end of the shaft.
2. Slide collar on shaft with eccentrically machined, recessed face against the inner bearing ring. Rotate the collar in the opposite direction of shaft rotation until eccentric faces of collar and inner bearing ring engage.
3. Continue to rotate the collar in the opposite direction of shaft rotation until snug. Complete tightening by inserting pin in drift pin hole of the collar and tap with lightweight hammer.
4. Tighten allen set screw.

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Chain Drive Adjustment and Maintenance

Airlock drive chain tension. Check tension of airlock drive chain every 200 hours as follows:

A. Remove chain guard. Airlock drive chain should have no noticeable sag between gearmotor and valve sprockets. However, chain should be loose enough to allow a slight up and down motion with hand pressure applied midway between sprockets.
B. To adjust airlock drive chain, loosen two bolts securing gearmotor and change position of gearmotor to obtain desired degree of tightness. Tighten mounting parts and reinstall chain guard.
C. Clean and re-grease chain every 500 hours.

Inspection and Repair

Inspection and repair procedures given below provide sufficient information for restoring the package to peak operation. In most cases, repair simply consists of component replacement.

A. If airlock is not operating efficiently or satisfactory, remove from system, inspect and repair in accordance with preceding information.
B. Inspect airlock drive chain and sprockets for wear, loose links, and damage. Replace chain and sprockets if damage is noted. Be sure the same size sprockets are replacements for original sprockets.
C. Inspect base structure, chain guard, and brackets, for damage and deformation. Replace defective parts.
D. Check all accessory equipment to assure proper operation. Replace any components found to be defective.

When requesting service assistance, please have the following information at hand prior to calling system engineer.

1. Blower speed.
2. Vacuum or pressure gauge reading.
3. Pressure switch setting.
4. Blower motor amperage reading.
5. Airlock speed.
6. Method of feeding the valve.
7. Gearmotor amperage reading
8. Conveying line length
   a) Horizontal run
   b) Vertical run
   c) Number of elbows

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Airlock Rotor Clearances

Model & Size	Standard Temperature Application	High Temperature Application
CI 6 x 6 CI 8 x 8 CI 10 x 10 CI 12 x 12	.004" - .007"	.007"-.010"
CI 14 x 14	.004" - .007"	.007" .010"
CI 16 x 16	.007" - .010"	.012" - .016"
CI 18 x 18 CI 22 x 22	.012" - .016" .012" - .016"	.012" - .016" .024" - .035"
CI 26 x 26	On Application	On Application
CI 30 x 30	On Application	On Application
MD 6 MD 8 MD 10 MD 12	.004" - .007"	.007" - .010"
MD 14 MD 16	-- .007" - .010"	--- .012" - .016"
AF-A AF-B	.004" - .007" .004" - .007"	.007" - .010" .007" - .010"
AF-C AF-D	.004" - .007" ---	--- ---
CDC-CI 6" CDC-CI 8" CDC-CI 10" CDC-CI 12"	.004" - .007"	.007" - .010"

BEST TO CONSULT FACTORY FOR CLEARANCES BEST SUITED TO YOUR SIZE ROTARY VALVE & APPLICATION.

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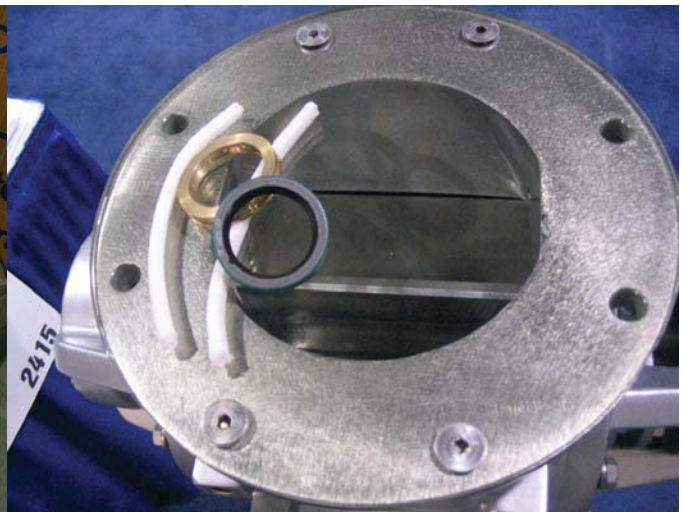
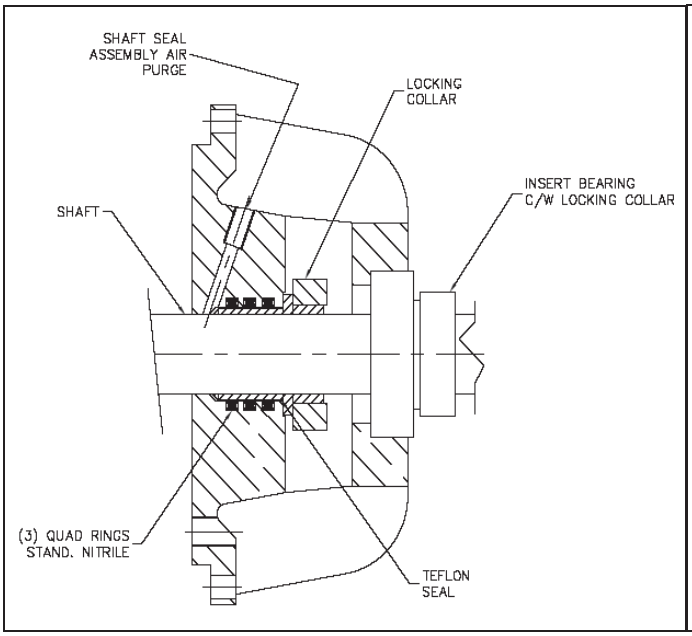
Shaft Seals

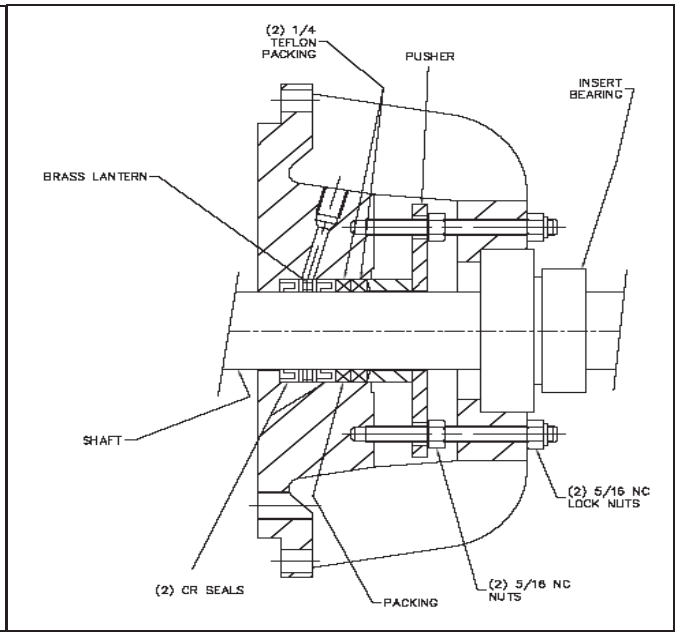
- ACST-4 shaft seals are used on both ends of the rotor shaft for superior sealing
- Each shaft seal assembly consists of one virgin teflon sleeve and three quad rings, which fit snuggly over the teflon sleeve
- The teflon sleeve has a smooth self lubricated surface creating a tight seal with the quad rings
- Also available in a packing gland style shaft seal air purge assembly consisting of a lantern ring, 2 lip seals, lot teflon packing and a adjusting pusher plate
- Air purge seals connection option for severe applications

ACST-4 Shaft Seal

ACS Packing Gland Style Shaft Seal with Lantern Ring







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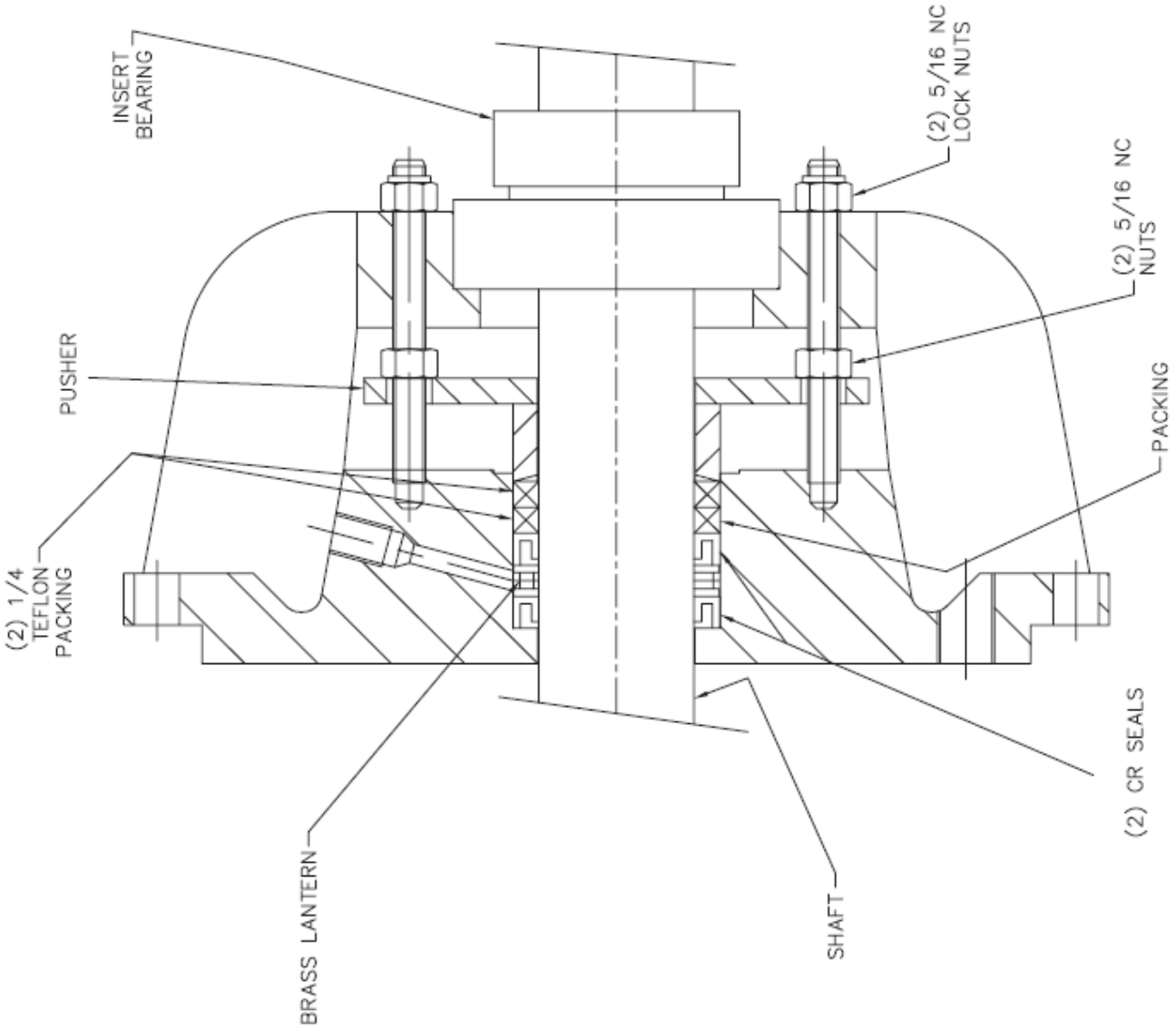
Packing Gland Shaft Seal Assembly



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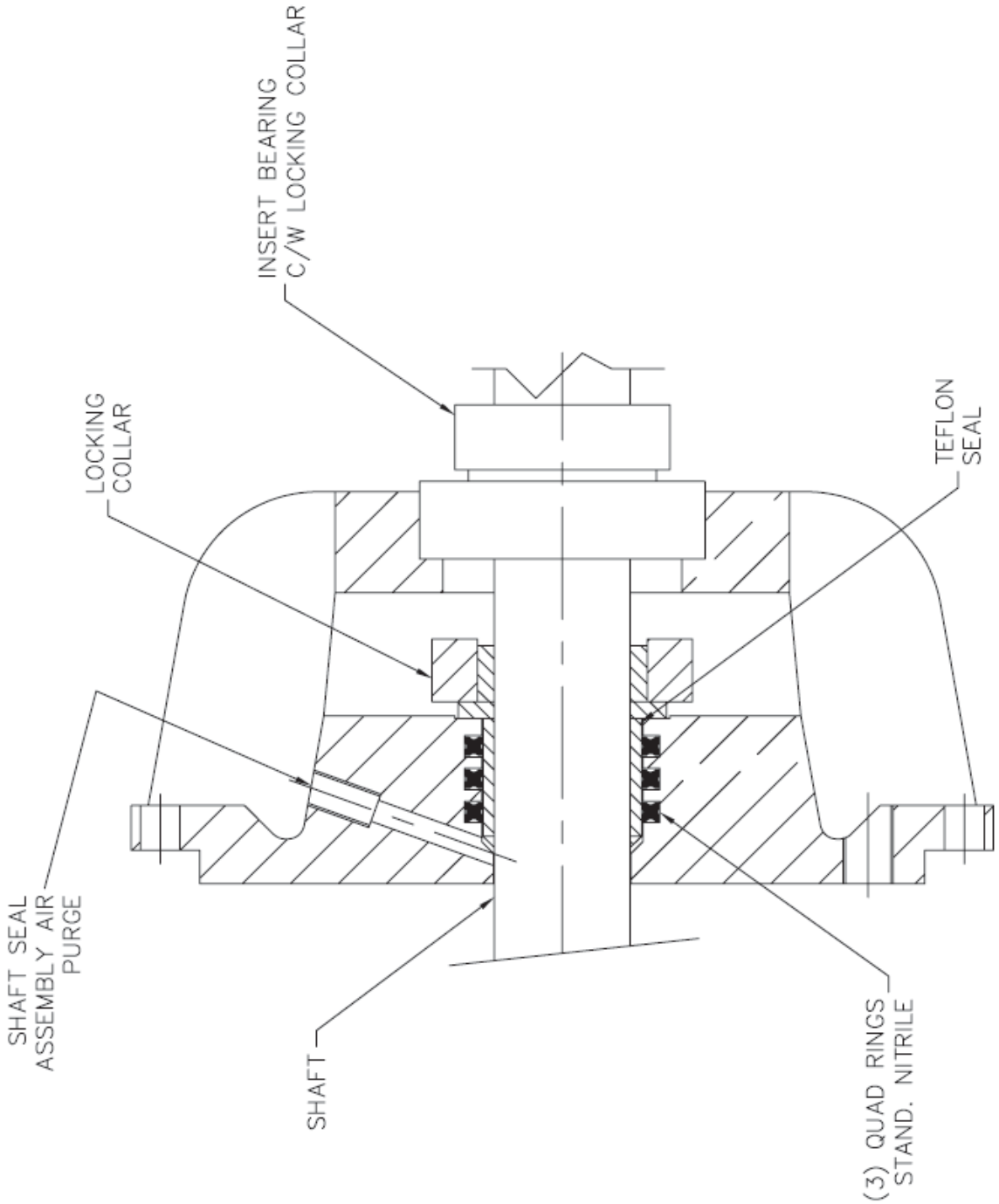
ACST-4 Shaft Seal Assembly



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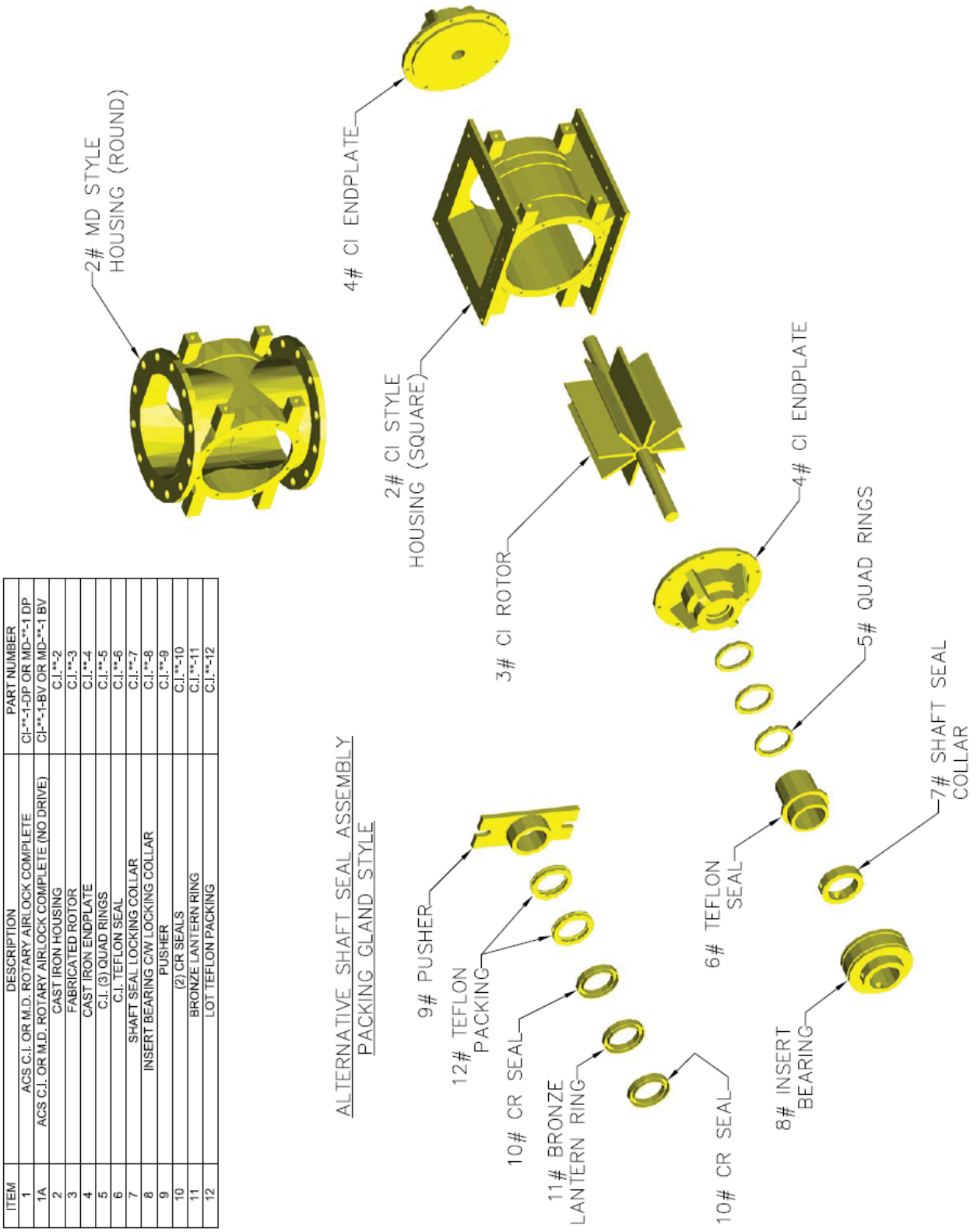

ITEM	DESCRIPTION	PART NUMBER
1	ACS C.I. OR M.D. ROTARY AIRLOCK COMPLETE	CI-**-1-DP OR MD-**-1 DP
1A	ACS C.I. OR M.D. ROTARY AIRLOCK COMPLETE (NO DRIVE)	CI-**-1-BV OR MD-**-1 BV
2	CAST IRON HOUSING	C.I.**-2
3	FABRICATED ROTOR	C.I.**-3
4	CAST IRON ENDPLATE	C.I.**-4
5	C.I. (3) QUAD RINGS	C.I.**-5
6	C.I. TEFLON SEAL	C.I.**-6
7	SHAFT SEAL LOCKING COLLAR	C.I.**-7
8	INSERT BEARING C/W LOCKING COLLAR	C.I.**-8
9	PUSHER	C.I.**-9
10	(2) CR SEALS	C.I.**-10
11	BRONZE LANTERN RING	C.I.**-11
12	LOT TEFLON PACKING	C.I.**-12

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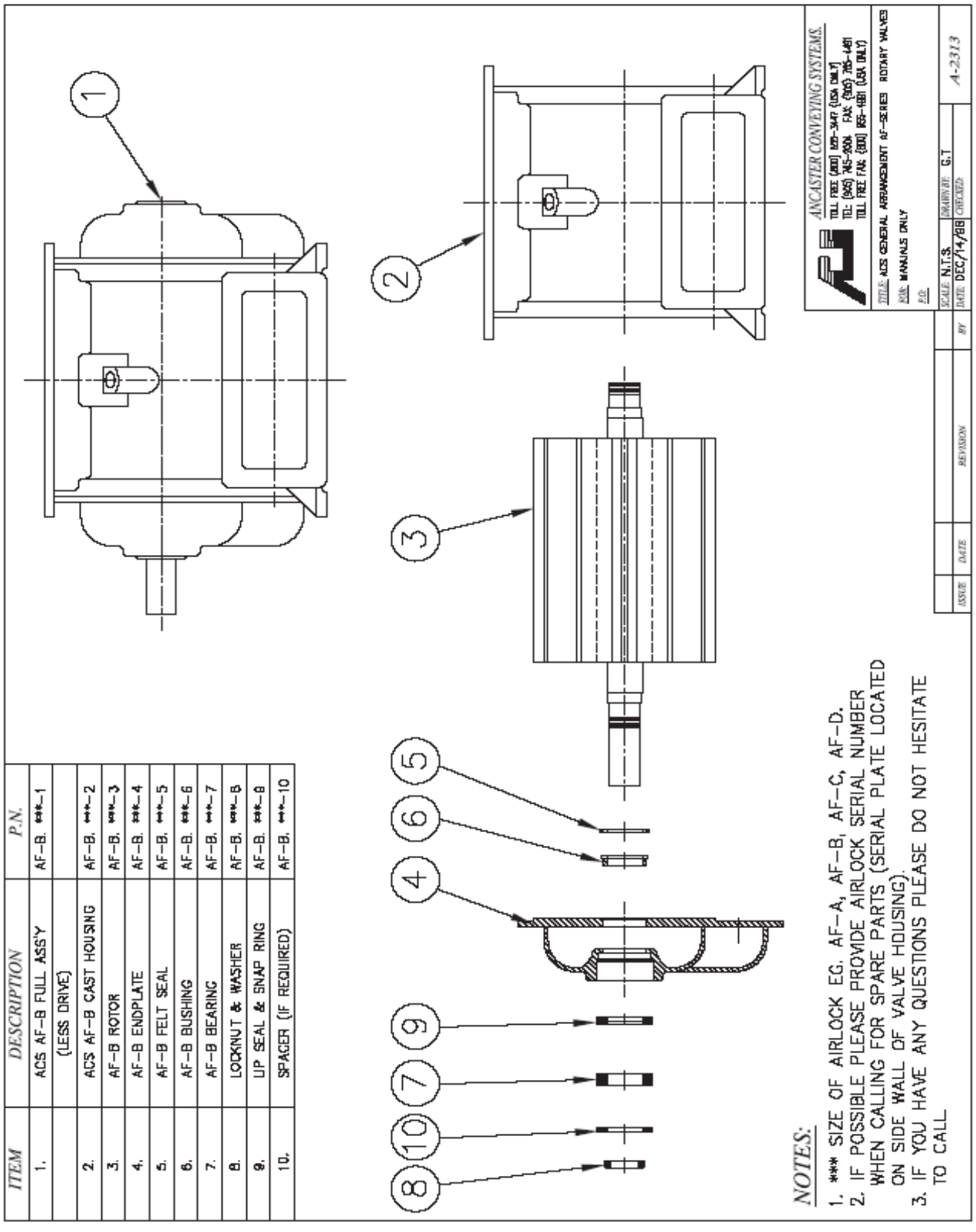

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Terms and Conditions of Sale

These General Conditions of Sale are and shall be applicable to all sales of products and services of Ancaster Conveying Systems ("ACS"). No other or inconsistent conditions of sale shall be binding upon ACS unless specifically agreed to in writing by an authorized official of ACS. ACS' distributors and sales representatives are not authorized officials of ACS for purposes of this provision. Any failure by ACS to object to any inconsistent condition or other communication from a buyer of production or services from ACS shall not be construed as an acceptance of such other inconsistent provision or as a waiver of these General Conditions of Sales

PRICES: Published prices on standard products and services are subject to change without notice. Verbal quotations on custom productions or special services expire at the close of the business day they were made, if not first accepted in writing or withdrawn. Written quotations for custom productions or special services expire 30 days from the date which they bear, unless earlier withdrawn or unless the quotation specifically provides another expiration date.

OFFICIAL CORRESPONDANCE: All official correspondence to include, but not limited to Purchase orders, Specifications, Samples, Construction Drawings, Approval Documentations, Shipping Status, Reports, Shortages of Incorrect Equipment Claims and/or Warranty Claims must be made and addressed to ACS at its principal office in Caledonia, Ontario.

ACCEPTANCE: No purchase order shall be valid and/or binding upon ACS unless first accepted by ACS at its principal office in Caledonia, Ontario.
TERMS OF PAYMENT: Unless otherwise agreed to in writing, payment is due:

a) Net within 30 days from the date of invoice from buyers whose credit has been approved by ACS.
b) Upon delivery for all other buyers. ACS with charge a 1 ½ % per month service and carrying charge with respect to all balances which are not paid when due. If a shipment of ACS' products is delayed by the acts of omissions of a buyer, payment shall become due at the time such products would have been shipped and the products will thereafter be stored by ACS at the buyer's expense and risk.

CONFIDENTIALITY: All proposals and price quotations, including any drawings prepared by ACS are confidential and remain the property of ACS. Transmission of all or any part of such information to others, or the use of any such information for the purpose other than considering the purchase of the products described, is prohibited.

TAXES: Any federal, state, provincial or local tax, tariff or charge of duty levied on the sale by ACS of any product or service or on the use or possession of any product after shipment by ACS shall be borne by and paid for by the buyer. If ACS is required by law to collect any such tax, tariff, charge or duty, the buyer will pay the amount thereof to ACS on demand or provide to ACS at the time the purchase order, any applicable exemption certificate or additional documentation.

RESPONSIBILITY FOR DOCUMENTS: Any documents, drawings or samples submitted with a purchase must be picked up by the buyer within a 30-day period. ACS shall no longer be responsible for any such items and may discard them.

ESCALATION: Any price quoted by ACS is calculated on the basis of wage and materials cost in effect at the date of the quotation and may be subject to increase to reflect increases in wage and/or materials cost accordingly.
CHANGES IN SPECIFICATIONS: No specification change shall be valid unless in writing, signed by ACS and the buyer of the product.
LOCAL CONDITIONS: ACS shall not be responsible for determining whether products furnished to any buyer comply with local conditions, codes or interpretations. The buyers of the product shall have the sole responsibility for assuring such compliance.

SHIPPING: Shipping dates are approximate and are dependant upon availability of materials and the cooperation of the buyers. ACS shall not be subject to any liability because of delay in shipping resulting from strike, accident, weather, fire or other conditions beyond ACS' control. ACS shall not be responsible for damage or loss in transit, and the buyer of any product shall have the sole responsibility to pursue any claims against a carrier.

SHORTAGES OR INCORRECT EQUIPMENT: Claims by a buyer of products from ACS for shortages or incorrect products must be made in writing within 10 days after receipt of the shipment by the recipient. Failure to give such written notice to ACS shall constitute in an unqualified acceptance of the shipped products and waiver of any claim by the buyer.

INSTALLATION: Installation of the Products shall be at the expense of the buyer. ACS can provide installation and start-up service.
In any case where ACS is utilized, the buyer shall nevertheless be obligated to furnish all necessary skilled and unskilled labor, tools, rigging and appliances with respect to the erection of a Product, without responsibility or liability of ACS.
If a Product is installed without ACS' assistance, ACS warranties contained in these general conditions shall not be applicable in the event of any claim of damage which, in ACS opinion, results from inadequate or faulty installation.

WARRANTY: ACS warrants its Products on the following terms and conditions only. THESE EXPRESSED WARRANTIES ARE IN LIEU OF ANY OTHER OBILGATION OR WARRANTY, WHETHER EXPRESSED OR IMPLIED OR ARISING BY OPERATION OF LAW.

a) ACS warrants that each of its Products shall be free of defects in workmanship and materials for a period up to one year from the date of installation (but not to exceed 18 months from the date of shipment by ACS from its factory)
b) ACS warrants that any of its custom Products which are manufactured in accordance with specifications, drawings, plans and designs set forth in writing by the buyer shall reasonably conform to all such written specifications, drawings, plans and designs.
c) The warranties set forth in (a) and (b) above are subject to and limited by the following:
    I. ACS' warranty with respect to a component of a Product supplied by another shall not exceed the warranty of the other supplier in terms or conditions.
    II. ACS' warranties shall be inapplicable if in the opinion of ACS, the Product has been mechanically, electrically or environmentally abused or altered, or if the Product was improperly installed.

III. ACS' warranties are applicable only within the continental boundaries of the United States, Hawaii, Canada and Alaska.
IV. ACS' warranties are limited to the supply of replacements for the defective part(s), FOB factory.

THIS WARRANTEE IS EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTEESS, EXPRESS, IMPLIED OR STATUTORY, INCLUDING BOTH BUT NOT LIMITED TO THE WARRANTEE OF MECHHANTABILITY. THE WARRANTEE OF FITNESS FOR USE AND THE WARRANTEE OF FITNESS FOR ANY PARTICULAR PURPOSE AND EXCLUDES ANY CLAIMS FOR INDIRECT OR CONSEQUENTIAL LOSSES OR DAMAGES. BUYER ASSUMES ALL RISK AND LIABILITY FOR LOSS, DAMAGE OR INJURY TO THIRD PERSON OR PROPERTY ARISING FROM THE USE OF GOODS SUPPLIED BY SELLER TO BUYER. BUYER AGREES TO DEFEND, INDEMNIFY AND HOLD HARMLESS SELLER AGAINEST LIABILITY OR OBLIGATION THAT ARISE FROM CONTRACT OR TORT, INCLUDING BUT NOT LIMITED TO NEGILIGENCE INCLUDING STRICT LIABILITY OR OTHERWISE WITH RESPECT TO ANY INDIRECT OR CONSEQUENTIAL DAMAGES, LOST PROFITS, OVERTIME , REPLACEMENT EQUIPMENT OR SERVICES, PENALTIES, LOSS OR DAMAGE TO BUYER OR ANY THIRD PERSON. IF THE GOODS THAT ARE THE SUBJECT OF THIS AGREEMENT CANNOT BE IN THE SELLER(S) DETERMINATION, ADEQUATELY REPAIRED OR REPLACED, SEELER(S) LIABLITY SHALL NOT EXCEED REPAYMENT OF THE AMOUNT OF PURCHASE FUNDS RECEIVED FROM BUYER.

GOVERNING LAW: Ontario law shall be applicable with respect to, and interpretation of these General Conditions of Sale.
RETURNS/CANCELLATIONS BY BUYER: Unilateral cancellation of a purchase order to ACS shall constitute a breach of contract and shall be subject to a cancellation/restocking charge. This charge shall be a minimum of 30% of the purchase order value and a maximum charge of the selling price of all materials and labor, purchased or expended by ACS to compensate for the disruptions in scheduling, planned productions and other direct costs. No approval shall be granted for the return of Goods under any circumstances where the original invoice date for such Goods is more than one-hundred eighty (180) days prior to the date that a request is made to ACS for such approval. No credit will be issued for returned Goods where the net amount involved is less than $100.00, except when an error made by ACS is to be corrected.